FATIGUE OF WORKERS

Its Relation to Industrial Production

BY

COMMITTEE ON WORK IN INDUSTRY

OF THE

NATIONAL RESEARCH COUNCIL

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Introductory Statement

The Committee on Work in Industry of the National Research Council have the honor to present a report of their studies, deliberations, and recommendations.

I. Introduction

At the first meeting of the Committee, all the members found themselves in agreement about the general definition of their duties. They recognized that the Committee had been formed to consider, not work in industry, but knowledge of and researches into work in industry.

The members of the Committee were accordingly unanimous in the belief that their primary aims should be two: first, to recognize and report on results of scientific investigations that bear upon conditions of work and that are not being effectively taken into account in practice, and, secondly, to report on lines of investigation and problems of a general character that have proved fruitful of new information and that may perhaps seem worthy of promotion.

It was recognized that many aspects of work in industry are the subjects of careful investigation by economists, by sociologists, by psychologists, and by students of preventive and industrial medicine. It was further recognized that, in general, well-established lines of investigation within the fields of well-established departments of science tend to evolve in a manner that is satisfactory and effective. It was therefore decided that the Committee should, in principle, confine its deliberations to matters that fall more or less outside the fields at present set apart as belonging to such sciences, or that are not being studied by specialists in these fields.

It was further recognized that the Committee as constituted was better qualified to study and to report upon researches already performed or in progress than to devise new projects of research; that it was better qualified to consider studies of the actual conditions—physiological, psychological, and pathological—of men in industry than to appraise the merits and demerits of most projects for the improvement of these conditions; and that the Committee was constituted for the purpose of considering studies of actual conditions, rather than more general or abstract problems.

These decisions and beliefs of the Committee and all its activities have been governed by a simple consideration. The policies and practices of industrialists, of managements, and of foremen; the policies and practices of trade-unions and of the agencies of government; the statutes enacted by Congress and by state legislatures—these things are all applied to men and women; they act upon human beings and modify them. As a means of planning, of judging, and of adjusting such procedures, it seems expedient to know as much as possible about what these actions and these modifications of men and women are. Today little enough is known about such things; and even the facts that are known are not generally appreciated among those whose decisions determine or help to determine the experience of men and women at work in everyday life. The Committee have felt that they were chosen because they were believed to have a special competency to study facts and the means of procuring more facts; that they have no special competency to consider most of the questions of policy or those that arise in practice; that the problem of describing conditions is one thing and the problem of improving them is another; and that in scientific work it is well to separate studies of the two kinds of problems. They have proceeded accordingly.

II. Hearings and Deliberations

Most of the work of the Committee has been devoted to hearings at which investigators have reported on their studies and discussed them with the members of the Committee. These proceedings have been digested and summarized by Mr. George C. Homans in the document which makes up the body of the present report.

In spite of the limitations upon its work which the Committee set up, these hearings have covered a wide range of subjects, passing from biological through psychological to social phenomena. The first of these subjects may be described as the synthetic study of the physiological conditions of men at work. In Mr. Homans' summary of hearings, the testimony on the effects of heat and on the effects of altitude and of lack of oxygen fall under the first, or biological, division. Such studies differ from those usually pursued in physiological laboratories in that they are designed to afford a picture of the physiological states of *individuals*.

Now it is possible in some instances to describe these states usefully by reference to some one physiological process; but in general this is impossible. All physiological states are constituted by the

interactions of an indefinitely great number of processes and, as a rule, no useful conception of such states is possible that does not take account of the interactions of a certain number of these processes. When it is a question of explaining the manner of production of a particular physiological state and the reactions by which the resting or so-called basal state is recovered, this is even more necessary.

The aim of such studies, in short, is not merely to find out how the several physiological functions are operating at a particular time but to find out how they are combined and in what manner they interact in each individual organism. In this respect such work resembles the task of physicians, who also must consider the interactions of the several functions in their patients. It differs from the task of the physicians in that the subjects are in general normal rather than pathological individuals.

A second class of investigations is illustrated by the extension of this kind of work to include studies of physiological psychology. As the testimony shows, this is a problem that did not present itself as seriously important in the case of the investigations of the effect of high temperature; but in the studies of the effect of altitude and of low pressures of oxygen it cannot be neglected, and where the circumstances involved in actually piloting an airplane at high altitude present themselves for study, the consideration of the interaction of the various other physiological factors with the psychological factors becomes a matter of the very first importance.

Occasionally, the results of such studies, like the results of medical researches, seem to be applicable to actual working conditions with a minimum of uncertainty and complication. Thus the study of heat cramps, summarized below, clearly shows that the effective prevention of this occupational disorder was accomplished according to an *a priori* fairly obvious scheme of action and with relatively little difficulty. Nevertheless, the Committee feel constrained to point out that even here interests of persons and groups of persons, prejudices, habits, and traditions were involved; that these factors had to be taken into account; and that, but for good fortune, they might have prevented effective application of obviously important scientific knowledge.

Some of the information about the state of the aviator is in like manner applicable, probably without serious difficulty, in the aviation industry. For example, it is already well known that rules concerning an artificial supply of oxygen can be made and applied and that such rules are, upon the whole, effective in eliminating

many risks. However, the experiences of a pilot involve so many more factors which bear upon questions of safety and of efficiency that simple, direct applications, even of extensive studies of the individual, are often difficult, and probably nearly always so complex that the *a priori* planning of applications must be performed with great caution. Accordingly, the Committee feel that even here, where the problems so much resemble those of medicine, a distinction between the advancement of knowledge and the application of knowledge is a matter of the very greatest importance.

The study of the interview as a psychological procedure falls into another class of investigations. This bears some relation to the physiological studies already referred to in that it seeks as the final goal information that is rather synthetical than analytical and in that it deals with problems bearing on individuals in their actual situations. Such studies differ from the physiological studies in that they cannot at present be quantitative and in that the analysis is necessarily in other respects also less sharp than physiological analysis. Just as the physiological work above referred to finds its analogue in the work of the practising physician when he makes a physical examination, so the interview is analogous to the work of the physician in "history-taking." Work of this kind is evidently more empirical, less theoretical, and somewhat less systematic than physiological research.

The Committee feel that the evidence justifies the following conclusions: first, that the interview is a useful and frequently indispensable means of investigation in industry no less than in the practice of medicine; secondly, that it has already yielded information of great theoretical importance; thirdly, that it has proved useful in certain instances where it has been used in practice; fourthly, that the training of effective interviewers has been successfully performed in a large number of instances.

We also feel obliged to point out that the use of the interview in practice, like the application of particular physiological or experimental psychological results in aviation, is a very complex matter involving the interaction of this procedure with a great many other procedures, under the influence of such constraints as individual interests, group interests, habits, and prejudices. Therefore, the application of the interview in practice calls for special training, experience, and skill and for a just estimate of all the circumstances.

Another class of studies may be described as those in which the attempt is made to diagnose as completely as may be the concrete situations in which individuals find themselves and in which, there-

fore, the social environment is also involved, or more explicitly involved than in the investigations above referred to. Such studies were reported by Dr. G. Canby Robinson and by those who spoke of the work at the Western Electric Company, and Mr. Chester Barnard and Mr. Harold Ruttenberg had much to say along the same lines.

Dr. Robinson's statements point to the importance of the social environment as a factor—often an important etiological factor—in illness. Not infrequently it is the social environment during work that proves to be the significant source of trouble. During the last half century the advances of medical science, the increase of specialization in medicine, and the changing conditions of urban life have all contributed to the establishment of habits and conditions of medical practice which tend to obscure the importance of such things. In particular, it may be noted that physicians practising in cities are rarely so well acquainted with their patients that they know intuitively or easily suspect factors of this kind.

The researches at the Western Electric works in Chicago,[1] especially the long and elaborate study of the so-called Relay Assembly Test Room, clearly show that the social environment is at least as important in the understanding of the conditions of men at work as it is for the practising physician. The Committee find that these researches seem to have fully established the importance of the social interactions between persons in industrial work and to have afforded a description of certain aspects of the spontaneous social groups that are formed among industrial workers. It seems clear that such interactions and such groups are matters of so great importance that they can hardly ever be safely disregarded in making a diagnosis of any concrete industrial situation.

The Committee wish to emphasize particularly the proof that even in industry economic incentives often appear to be negligible factors in determining behavior. Mere casual consideration might suggest that this would be not infrequently true, just as it is obviously true in respect of such problems as heat cramps, the lack of a suitable supply of oxygen in aviation, and in the causation of all sorts of diseases; but this investigation goes far to prove that such conditions are much more frequent than might have been expected and still more frequent than the prevalent economic interpretation of human behavior would suggest. The conclusions of the Western Electric investigation are strongly supported by the testimony of

[1] Cf. Roethlisberger and Dickson, "Management and the Worker," Harvard University Press, Cambridge, 1939.

Mr. Ruttenberg and by that of Mr. Barnard, whose recent book[1] throws much light on this subject.

The results of these Western Electric investigations are sometimes little more than clear formulations of principles that discerning, practical men have vaguely understood or perhaps acted upon without any conscious awareness. The testimony of Mr. Ruttenberg bears especially upon this point. In the opinion of the Committee nothing could more strongly suggest the importance of the conclusions; for it is clear that such empirical or intuitive knowledge of practical men on the one hand strongly supports the conclusions and, on the other hand, because it has remained empirical or intuitive, indicates that it is not being systematically utilized in practice.

On the whole, the hearings strongly suggest that studies of the conditions of work in industry, like studies of sick people, cannot be safely pursued to the point of diagnosis without taking account of all the different kinds of factors mentioned above. These include physiological factors, psychological factors that are closely related to physiological processes, the more general psychological factors that we associate more particularly with personality and attitudes, and all sorts of social factors. Moreover, it seems clear, both because of the relatively advanced state of physiological science and because many departments of psychology and of sociology are still in a primitive condition, that it is easier to rule out the physiological factors and in suitable cases safer to disregard them than it is to leave out those factors that are concerned with the personality and the social environment of an individual.

III. General Conclusions

If we assume that the understanding of concrete industrial situations must in general involve a consideration of all the kinds of factors just enumerated, it seems a fair inference that the task of studying such phenomena resembles that of studying sick people rather than that of the physiologist, the psychologist, or for that matter of the academic sociologist.

Three qualifications seem to be necessary to carry out such studies. In the complex business of living, as in medicine, *both* theory and practice are necessary conditions of understanding, and the method of Hippocrates is the only one that has ever suc-

[1] Barnard, C. I., "The Functions of the Executive," Harvard University Press, Cambridge, 1938.

ceeded widely and generally. The first element of that method is hard, persistent, intelligent, responsible, unremitting labor in the sick room, not in the library: the complete adaptation of the doctor to his task, an adaptation that is far from being merely intellectual. The second element of that method is accurate observation of things and events, selection, guided by judgment born of familiarity and experience, of the salient and the recurrent phenomena, and their classification and methodical exploitation. The third element of that method is the judicious construction of a theory—not a philosophical theory, nor a grand effort of the imagination, nor a quasi-religious dogma, but a modest, pedestrian affair, or perhaps one had better say a useful walking stick to help on the way—and the use thereof. All this may be summed up in a word: The physician must have, first, intimate, habitual, intuitive familiarity with things; secondly, systematic knowledge of things; and thirdly, a useful way of thinking about things.

The Committee find that the most effective work brought to their attention has been done by persons who possess in some measure, or are consciously striving to acquire, these three qualifications: intuitive familiarity, systematic knowledge, and a useful way of thinking. They believe that the success they have noted in these investigations has been largely due to the possession of these qualifications, to awareness of their importance, and to the resulting interest in the total situation which was the subject of investigation. Analytical studies designed to determine single elements of the total situation are, of course, essential to the advancement of all kinds of scientific work. They need to be prosecuted as actively as ever; but they are being widely prosecuted and there is no lack of understanding of their importance. On the other hand, studies of the kind now in question are few, and the appreciation of their importance is limited to a few persons only. We are glad to note that Dr. A. V. Bock, Professor of Hygiene in Harvard University, has undertaken a study of a large selected group of undergraduates in which he is endeavoring to combine a great number of sound methods of investigation with the purpose of establishing facts that may be the basis for a diagnosis of the total states of the subjects of the study. This research, carried out under the auspices of the W. T. Grant Foundation, is in an early stage. Nevertheless, it calls for notice here because it conforms very closely to those characteristics, specified above, that the Committee have recognized in the studies reported to them. Such is the most important general conclusion of the Committee concerning *methods* of advancing knowledge of the conditions of work in industry.

The most important *result* of investigations of this kind seems to the Committee to be the proof that the individual is powerfully actuated by a desire for an intimate and routine relation with his fellow workers, a desire which when satisfied makes for well-being, when unsatisfied for distress, and that this desire leads him to subordinate his own material interests and his own independent thinking. It seems to be one of the chief human traits that, in successfully adapting himself to work, an individual subordinates many of his own sentiments to those that are a necessary part of routine association with his fellows. This surely is a characteristic of all society and particularly of all stable society. We find that it is an element ordinarily neglected in appraising industrial situations and suggest that it is probably the most important neglected element.

Closely related to this are the need for self-expression through participation, pointed out by Mr. Ruttenberg, the frequently noted effect of the interview upon the person interviewed, which is reported in the account of the work of the "counselors" at the Western Electric Company, and probably other obscure psychological processes.

Such phenomena as these, which may be described as falling within the range of social psychology, need to be taken into account in practice. The Committee feel that it is their duty to point out this need, but that they should not prescribe or even suggest the manner in which such results of inquiry are to be practically applied. This is, indeed, an extreme example of the kind of knowledge that can be effectively applied only when many other factors in a situation are also given their due weight. Our evidence seems to show that, during the period in which it has been used, the system of counseling in the Western Electric plant has produced valuable results; and Mr. Ruttenberg has testified that methods employed in the reorganization of conditions in plants in the Pittsburgh district, involving a totally different procedure but nevertheless taking account of the same factors, have also had excellent results.

Such evidence strongly supports our conclusion that it is of practical importance to take these factors into account; but the Committee are in no position to express an opinion about the utility in the long run of these special procedures or about other means —presumably, in the total very numerous—that might be devised as alternative procedures.

In sum, the Committee wish to emphasize two things:

First, for the study of work in industry a procedure like that of the clinician is often indispensable.

Secondly, in such studies and in practice the influence of spon-

taneous groups is often the most important and often the neglected factor.

A full treatment of these and other questions that have come before the Committee will be found below in Mr. George C. Homans' summary of our proceedings. The Committee are greatly indebted to him for his excellent presentation of a difficult and intricate subject.

L. J. Henderson, *Chairman*
Elton Mayo
F. W. Willard
W. S. Hunter
G. Canby Robinson
H. J. Ruttenberg
George C. Homans, *Secretary*

Report of the Committee

by

George C. Homans

I. Introduction

On November 13, 1937, a "Conference on a Scientific Study of Industrial Labor Conditions" was held in Washington under the auspices of the National Research Council. Professor Lawrence J. Henderson was chairman. Following this conference, and in accordance with a vote of the administrative committee of the National Research Council, a "Committee on Work in Industry" was appointed on December 4, 1937, by the President of the National Academy of Sciences. The Conference on a Scientific Study of Industrial Labor Conditions will hereinafter be referred to as the Conference, and the Committee on Work in Industry as the Committee. The members of the Committee were:

Chairman, Lawrence J. Henderson, Professor of Chemistry, Fatigue Laboratory, Harvard University.
W. S. Hunter, Professor of Psychology, Brown University.
Elton Mayo, Professor of Industrial Research, Graduate School of Business Administration, Harvard University.
G. A. Pennock, Manager, Apparatus and Cable Division, Western Electric Company, Hawthorne Works.
G. Canby Robinson, Lecturer in Medicine, School of Medicine, Johns Hopkins University.
F. W. Willard, President, Nassau Smelting and Refining Company.

On May 26, 1938, Mr. Pennock resigned. Thereupon the Committee decided that a representative of organized labor should be added to its membership, and at its request Harold J. Ruttenberg, Research Director, Steel Workers Organizing Committee, Pittsburgh, was appointed on February 28, 1939, a member of the Committee. This selection was made from a list of persons recommended by one of the country's prominent labor leaders. On June 15, 1939, George C. Homans, Instructor in Sociology, Harvard University, was appointed *Secretary* of the Committee. Ross G. Harrison, Professor of Zoology, Yale University, and Chairman of the National Research Council, frequently attended meetings of the Committee *ex officio*.

According to the statement made at the time of its appointment, the Committee was to "consider the scientific study of physiological

and psychological discomfort and distress of workers in industry." This main purpose may be subdivided as follows: (1) to study projects of research recently completed or still being carried out within the field of industry, (2) to formulate the tentative results reached by these researches, and (3) to state whether it is desirable, in the interests of the country, of science, and of the general welfare to obtain by investigation such information as may be had about certain kinds of industrial problems. Accordingly, the Committee proceeded to hold a number of meetings and take testimony. The following report summarizes the testimony given before the Conference and the meetings of the Committee.

The field of industrial research considered here is limited in at least two respects. In his remarks opening the Conference, Professor Henderson pointed out that scientists of different kinds were devoting an immense amount of time to the problems of industry, and that the National Research Council was not particularly well qualified to undertake a study in competition with these men. Therefore the work of the Conference and the Committee was by agreement limited to those aspects of industry which the established sciences do not in general consider, that is to say, to problems, methods, and the study of what may be done in fields which established scientific disciplines either do not deal with at all or do not deal with in their most central features.

Illustrations are in order. There is a well-established field of industrial medicine concerned with such problems as industrial poisons and accidents. The Conference and Committee considered various projects of medical research in industry, but never any falling unmistakably within the field of industrial medicine as at present established and effectively practised.

Again, an important field of work in industry is that of personnel work. It includes such problems as placement, aptitude for industrial work, and industrial social service. Men working in this field have developed a recognized discipline of their own, and this field the Conference and Committee did not invade. The projects of research they studied lay outside the field of personnel work as usually conceived. In particular, the Committee decided not to explore the labor relations policies of a sampling of American private enterprises for the reason that such an undertaking would extend far beyond the proper area of its mandate.

The work of the Conference and the Committee was limited in another respect. Testimony was heard only from persons who had intimate, first-hand acquaintance with the matters they were talking about. They spoke of their own researches, of their

own responsible work where that work had been carried on seriously for a long time, of problems which were a part of their immediate, concrete activity. The Committee felt that, though its findings might be limited in scope, they should at least be based on the closest possible approach to immediate experience.

In opening the Conference, Professor Henderson made these points clear, and then went on to offer some general considerations, citing the example of Hippocrates. He said that the Conference was concerned with the question of what happens to people in everyday life. At the present time, the study of people when they are not sick is much like the study of sick people as it was in the time of Hippocrates. Hippocrates was apparently in reaction against the myths and superstitions which then existed in the practice of medicine. Our views of what happens to people in everyday life are still highly colored by myths and traditions: those of old-fashioned conservatism, of Marxism, of psychoanalysis, and so forth. Hippocrates was in reaction against the then very recent intrusion of philosophy into medicine—as he expressed it, the use of postulates from which things are deduced, the postulates being mere words. It is hardly necessary to say that most of what we read today about the experiences of ordinary life is influenced in some degree by such philosophical considerations. Finally, Hippocrates was in reaction against the development of what seemed to be systematic knowledge on the basis of insufficient concrete information and fact. He was opposed to system-building until there was a sufficient foundation in fact. Yet from that day to this, the whole discussion of what men do and experience in everyday life has been marked by such system-building.

As opposed to such tendencies, which were for him dangerous, confronting the physician, Hippocrates applied a procedure the worth of which seems to be justified by the long history of science, at least where science deals with the complex phenomena of human activity, whether physiological, psychological, or social. Hippocrates was first of all a practising physician, and his judgment was dependent on that kind of intimate, habitual, intuitive knowledge which can be observed in the great physicians. He was a diagnostician, a man who often knew what a thing was before he was aware of his reasons for knowing it. Such an ability is not sufficient for scientific work, but unless a man has it to begin with, he does not get far in studying concrete things that are complex. Hippocrates also had a systematic way of thinking about things and an orderly classification of things. Such a scheme is necessary in the study of human behavior, but is usually lacking. If we think of the

number of diseases now recognized as specific in human pathology and ask ourselves what properties of men at work or what phenomena of any sort dealing with most aspects of everyday life are in the same way specific, we shall perhaps agree that there are none. We have neither specific causes nor specific cures. We have vague notions which involve exceedingly little classification.

Finally, besides intimate, habitual knowledge of things, and a systematic way of thinking about things, Hippocrates was concerned with having a useful, effective theory. His theory was a simple one, but it was one which on the whole worked, and all experience in science shows that it is necessary to have, not an elaborate and pretentious system of thought of the sort Hippocrates opposed, but a simple kind of theory which serves as a tool to help one get ahead slowly.

These are general considerations. Professor Henderson suggested that they should be kept in mind in the study of questions as difficult and complex as those which were to come before the Conference, that they not only described the work of one of the great men of medicine but were consistent with the history of science as a whole. He reminded the members of the Conference that in listening to the testimony to be presented to them they were investigating a question much larger and, from a scientific point of view, much more important than the question of what causes unhappiness and trouble among workers in industry. They were investigating the question of what happens to a man in his everyday life.

II. Heat and High Altitude

This report now considers the testimony taken by the Conference and the Committee. The first body of testimony was chiefly concerned with the physical conditions of work in industry. At the Conference, Dr. D. B. Dill of the Fatigue Laboratory, Harvard University, described the research carried out by the Laboratory on the problem of work under conditions of excessive heat, both humid heat, as in the tropics, and dry heat, as on the western deserts of the United States or in a steel mill in summer.

The first work of the Fatigue Laboratory on the subject of high temperature was done in 1930 at the Barro Colorado Island Biological Laboratory, Panama Canal Zone. In that environment the daily temperature is not very high or variable, but the humidity is extremely great.

Men depend on the evaporation of water for the control of body temperature; that is to say, when sweat dries, the body loses heat. If the humidity is great, so that the air is nearly saturated with water, sweat will not dry and the body is not cooled. The mere production of sweat is of no use. Accordingly, the problem of the dissipation of heat in the humid conditions of the tropics is an extremely serious one.

Another problem raised by humid heat is the following. The words are Dr. Dill's: "A man doing heavy work in the tropics of the United States during hot, humid, summer weather has a much higher heart rate than if he is doing the same sort of work in a pleasant environment." In part, the explanation of his high heart rate is that if body temperature is to be controlled, heat must be transferred from the regions where it is produced to the regions where it is to be dissipated. This transfer is effected in times of stress chiefly by circulation of blood to the skin. The blood is diverted from its usual channels and functions for this special purpose, and is not available for other purposes. Accordingly, an increased strain is placed on the heart. Therefore, "the limit of physical activity must be set at a lower level in the tropics or in hot, humid weather in this country. It is irrational to expect a man to do as hard work in the tropics or in humid heat in this country as he is able to do in a pleasant environment. It

has been suggested that this has not been properly appreciated by the white man in the tropics. He assumes he can do as much there as anywhere else. He finds that impossible. He also assumes that the native in the tropics should do as much work as the white man here, and he perhaps wears himself out trying to exact as much work as is expected of white men in this country."

The same problem arises when men are working hard while clothed in some kind of impervious clothing. The Fatigue Laboratory at one time worked in co-operation with the Chemical Warfare Service on clothing devised for protection against mustard gas. A light oilskin suit prevents the contact of gas with the skin. The suit perhaps keeps out the mustard gas, but it also keeps in the water produced by a man doing work. Therefore he soon creates within the suit an atmosphere saturated with water, so that evaporation of sweat from the skin no longer takes place. He creates a tropical atmosphere, and, as in the tropics, his heart rate increases to its limit. Dr. Dill described one experiment in particular: "We studied a man carrying a standard pack and wearing a woolen uniform with various combinations of protective clothing. We had him walk about two and a half miles an hour for three hours with a ten-minute rest period once an hour. We found that with ordinary clothing he could do this easily; at the end of three hours the heart rate was about 110 or 115. With the protective clothing the heart rate at the end of three hours had reached about 175. There were some changes also in the properties of the blood, but the outstanding event was a circulatory breakdown which came when the cardiovascular system was no longer able to cope with the difficulties experienced in the dissipation of heat. The skin temperature rose to nearly the internal temperature of the body. The natural consequence of that is the dilation of the vessels in the skin and diversion of blood from the muscles, where it is needed for oxygen supply, to the skin."

The problems of dry heat are somewhat different from those of humid heat. Sweat evaporates readily in dry heat; the skin temperature therefore remains comfortably low; the blood diverted to the skin is small in amount, and no great burden is placed on the heart. But other problems arise. In the year 1931, Boulder Dam was being built, and accounts appeared in the newspapers of severe conditions experienced by the workmen there. There were some fifteen deaths from heat and a large number of prostrations, heat cramps, and breakdowns of other types. Through Secretary of the Interior Wilbur, the Fatigue Laboratory secured the co-operation of both the government authorities and the private companies

building the dam, and in the summer of 1932 carried out a series of studies of workmen and of members of the Laboratory during the process of adaptation to dry heat. The workmen included a considerable number whose condition did not appreciably deteriorate, although they underwent a daily rhythm of considerable magnitude in the water and salt content of the body. When they started work in the morning they began at the same level as on the preceding morning. That is, their 24-hour cycle showed no retrogression. On the other hand, a certain number of workmen did collapse with heat cramps, and these men could be studied in the hospital. The investigations showed that in dry heat, such as that experienced in the desert, the body is successful in maintaining a comfortable temperature and a relatively low heart rate. There is no great swing in heart rate such as is observed in the tropics. But this result is accomplished by the evaporation of large quantities of water, with inevitable loss of considerable salt in the sweat produced. Most cases of breakdown were of men who had not maintained a proper salt balance.

This failure to maintain the salt balance is related to a poor instinctive mechanism of the human body. Herbivorous animals, as we know, have a craving for salt which satisfies their physiological requirements. Instinct apparently impels animals like deer to visit salt licks. On the other hand, the workmen and the research scientists at Boulder Dam frequently became deficient in salt, would even reach the breakdown state and suffer heat cramps, yet instinct never acted as a corrective. And since instinct was not operating, conscious planning had to take its place. Heat cramps were the result of a failure to maintain the salt balance of the body. Therefore the method to be used in preventing and curing heat cramps seemed to be obvious—an increase of the salt intake. As a matter of fact the efficacy of this method had been demonstrated by the British physiologist, J. S. Haldane, but the knowledge had not penetrated to Boulder Dam. Nobody appreciated that salt depletion was responsible for the breakdowns which occurred there. The scientists of the Fatigue Laboratory were able "to convince officials that the proper advice was not what they had been giving —to drink plenty of water—but rather to take plenty of salt; the water will take care of itself."

A further circumstance contributed to the difficulties of the first year of construction at Boulder Dam. The dormitory in which the men had been housed was located in the river canyon. "The shade temperature there frequently stays above 100° F. until past midnight, and during the day exceeds 110° F.; on three occa-

sions during the first year it reached 125° F. The men were working in three shifts, and after completing eight hours of work, they had the job of attempting to recover in heat that made sleep almost impossible and caused continuous sweating. Accordingly, the men were unable to restore their bodies to a normal state by the end of the 24-hour period. It is a safe deduction that they underwent severe metabolic changes and gross disturbances in water and salt balances during the worst heat spells."

In the summer of 1932 the dormitories had been established on a plateau nearly 1,500 feet above Boulder Dam, where the temperature is ten to fifteen degrees lower, and while they were of cheap wooden construction, they had air-conditioning equipment which made it possible for men on the night shift to sleep by day and for those on the day shift to sleep by night. At the time when the scientists of the Fatigue Laboratory were present, the average workman had become acclimatized and was able to carry on and enjoy life.

The experiences of Boulder Dam were repeated a little more than a year later. At that time the Fatigue Laboratory had some correspondence with the authorities of the Youngstown (Ohio) Hospital Association, particularly with Dr. P. H. Kennedy, the medical officer of the Youngstown Sheet and Tube Company. They had heard something about the studies made at Boulder Dam and were interested in having similar studies made in the steel mills, where heat cramps had been common. The outcome of the correspondence was an invitation from the Youngstown Hospital Association to come to Youngstown during the summer of 1934, the expenses of the study to be borne by the steel mills and facilities to be provided in the new hospital by the Youngstown Hospital Association. Mr. Edwards and Drs. Talbott, Dill, and Bock spent most of the summer studying conditions in the steel mills. Heat cramps were studied, also other forms of heat prostration.

At Youngstown, as at Boulder Dam, there had not been proper appreciation of the importance of salt for men doing work in dry heat, although this point had been for some years pretty well established in physiology. "One organization believed, or rather its medical authority believed, that the proper treatment for men with heat cramps was to inject a glucose solution; another recommended injecting a salt solution; and a third to play safe by injecting both salt and glucose." In a situation of this sort, the suggestion of any particular remedy is always met with a certain amount of skepticism, but the scientists of the Fatigue Laboratory were able to satisfy themselves, at Youngstown as at Boulder Dam, that there

was only one satisfactory method for the treatment of heat cramps: the administration of salt. "In critical or severe cases salt solution is injected under the skin or into the blood stream. In mild cases salt can be taken by mouth. Other methods of treatment appear to be ineffective."

Dr. Dill's statement continued as follows: "Dr. Kennedy had co-operated in these studies, and at the end of the summer he agreed with us that the best method of supplying salt to the workmen to protect them against heat cramps was not to rely upon voluntary use of salt tablets but rather to supply salt in the drinking water. Many have a prejudice against the use of salt for heat cramps because of the tradition that it endangers the kidneys, and many had superstitions regarding the prevention of heat cramps, especially the negroes. Some thought sulphur the best preventive: one negro was wearing a bag of sulphur around his neck and another had put sulphur in the bottom of his shoes. One curious thing we heard was that in one of the steel mills cramps were relatively uncommon, and the men were of the opinion that the water obtained from a local well was effective. We analyzed the water and found that it had a high salt content; this well evidently tapped an underground salt supply.

"Dr. Kennedy, with assistance from an engineer of the Youngstown Sheet and Tube Company, developed an automatic apparatus for administering salt to the men in their drinking water. Although the concentration of salt was low, it was enough to give the workmen all the salt they needed, and Dr. Kennedy reports that since this was installed they have had almost no heat cramps in these mills and that heat prostration has been considerably reduced."

Heat prostration is a clinical entity distinct from heat cramps. In part it appears to result from a reduction in the volume of extracellular body fluids, and this reduction takes place before the depletion of salt becomes acute. Nevertheless, here again the use of salt is important. If a man has an adequate supply of salt, he tends to drink more water and thus keeps the fluids more nearly at a normal level. Therefore he is in less danger of heat prostration. Salt in itself is not a preventive but it lessens the chance of heat prostration.

In conclusion, Dr. Dill reported that scientists from the Fatigue Laboratory had gone back to Boulder Dam during the summer of 1937 for a study of the mechanism of adaptation to high temperatures. No work was done with the employees of the dam; the scientists studied their own reactions, with particular reference to the chemical composition of perspiration and the adaptation of

the body to high temperatures. The following findings were reached: "first, that a man in midwinter or early in the season has a lower capacity for sweating than when he has been in high temperature for several days and, second, that the salt concentration in sweat falls off during the period of adaptation. It may fall off by one-half in a season. A man can do harder work after adaptation because more sweat is produced and his body temperature is regulated more effectively. As the summer advances he is less likely to break down because the sweat he produces contains less salt and his thirst maintains the body fluids nearer to a steady state."

In the discussion which followed Dr. Dill's remarks, a number of important points were raised. In the first place, Mr. F. W. Willard, of the Committee, reported that in the smelter and refinery of the organization of which he is president, the Nassau Smelting and Refining Company, during extremely hot weather and among men working on furnace operations, heat cramps and prostrations had once been a daily occurrence. In the last two years the medical officer of the company had supervised the administration of salt as best he could under rather difficult conditions. During the last two summers there had not been a single case of heat prostration or heat cramps. Mr. Pennock reported the same results in the Western Electric Company, Hawthorne Works, particularly among girls, and stated that heat prostrations had been practically eliminated.

Dr. A. J. Carlson, Professor of Physiology, University of Chicago, asked Dr. Dill how he reconciled his assertion that salt deprivation through sweating was not recognized by the individual, except perhaps as a general malaise, with the old records of specific salt hunger in various parts of the world. Dr. Dill replied: "I think it may be that a man may eventually learn without being aware of it that he does need salt. We made inquiries of men at Boulder Dam the first year we were there—of men who had been there more than a year—and found that hardly any had been aware of having increased the quantity of salt on their food, but when we asked them specifically if they were using more salt than had been their custom, several thought that perhaps they were. The matter had not occurred to them, but we believe that some were using more salt than before."

The question was raised of individual differences in susceptibility to heat cramps. No doubt exists that there is a considerable amount of sheer constitutional difference between men in this respect. Among the scientists of the Fatigue Laboratory, there were considerable variations in the capacity for sweat and in the amount of

salt produced in sweat. Dr. Adolph was able to put out sweat at only about two-thirds the rate the others attained. In other words, his capacity for temperature control was distinctly limited by the inability of the sweat to reach a high level of output. Dr. Dill himself was losing about twice as much salt as the others for a given amount of sweat. The man who breaks down with heat cramps is likely to be a man who passes out perspiration with a great deal of salt in it.

There is also apparently no doubt that men not physically fit are more susceptible to heat cramps than those who are. Men who are not physically fit will suffer heat cramps or exhaustion when they would not have suffered otherwise. J. S. Haldane reported that he was able to produce heat cramps artificially only in cases of men not physically fit. On the other hand, susceptibility is apparently not a function of age. Mr. Willard said that the feeling in his organization, not based on objective studies, had been that older men stood up under conditions of extreme heat better than younger men. But Dr. Carlson pointed out that the difficulty which arises over the question of age is the following: while it may be true that the men of forty and above get along as well as the young men, this result may not be due to the age variable, but rather to the fact that the younger men are out more at night and get less sleep. He thought the sleep factor was an important one.

Dr. Carlson also asked whether mental as well as physical fitness lessened susceptibility to heat cramps and prostration, whether people in any way unhappy will break down sooner. Dr. Dill replied: "Some men who are very happy become unconscious with heat exhaustion. They may say, 'Doctor, will you please count my pulse and take my blood pressure,' and go down while they are talking and laughing." In short, mental attitude will not overcome extreme physical conditions.

The second body of testimony which was presented before the Conference dealt, like Dr. Dill's, with adaptation to extreme physical conditions. Dr. Ross A. McFarland, Assistant Professor of Industrial Research, Graduate School of Business Administration, Harvard University, spoke on "The Psychophysiological Effects of High Altitudes." He pointed out that the research he described is of practical importance in aviation and in the operation of mines and other properties at high altitudes. It is also of theoretical interest in the attempt to understand certain basic processes in biology and psychology.

The condition which occurs at high altitudes, as a result of lowered barometric pressure, is called anoxia, lack of oxygen. It is well known that all the tissues of the body are extremely sensitive to diminished oxygen and variations in carbon dioxide. There is no storage of oxygen in the organism, unless the splenic reservoir of red cells or oxygen carriers be considered such. Oxygen is transferred to the blood in the alveolar cavities of the lungs by a process of diffusion. The blood takes up the oxygen by means of hemoglobin, located in the red cells, and carries it to the tissues. The organism immediately compensates for any deficiency by increases in pulmonary ventilation, in the output of the heart per beat, in the number of red cells, and in other complicated ways too numerous to mention here. It appears that the nervous tissue is the first to suffer from anoxia. Therefore the neurological symptoms are the most common. The digestion is upset and other important changes take place throughout the organism. "Finally, skeletal muscle, although it is not easily damaged by deficient oxygen supply, has a greatly lowered capacity for energy production; in other words, man can do less work at great heights than at sea level. These effects can all be summed up in a sentence: Every physiological function depends upon the supply of oxygen, and when this is reduced the function must be restricted proportionately."[1]

A particular interest in the study of anoxia is best described in Dr. McFarland's own words: "In a discussion of Claude Bernard's well-known statement, '*La fixité du milieu intérieur est la condition de la vie libre*,' Professor Barcroft states that the organism, in gaining constancy of temperature, hydrogen-ion concentration, water, oxygen, salt, etc., ultimately reached a stage of development such that man's higher faculties could appear. A marked variation in any one of these organic constants produces striking effects on the central nervous system. Again, Professor Cannon's experiments have demonstrated the importance of a constant and adequate oxygen supply in the maintenance of 'homeostasis,' or the 'steady state' of the internal environment. Although it is recognized that an intimate relationship exists between sensory and mental functions and the underlying physicochemical processes of the internal environment, only a few quantitative studies have been made in which both have been measured at the same time." Studies of oxygen deprivation seem to offer a convenient point of attack, although variations in salt, sugar, temperature, etc., may prove to be just

[1] D. B. Dill, "Life, Heat, and Altitude," Harvard University Press, Cambridge, 1938, p. 146.

as interesting in this respect as anoxia. In short, the study of anoxia is the study of the relation between the higher faculties of man and their physiological foundation. It is broadly psychological.

Dr. McFarland stated that his testimony was presented from the point of view of experimental psychology. He felt that academic psychology, based on introspection, was liable to obvious error, and that even the measurement of sensory and mental phenomena, without some control of the underlying physicochemical processes, was certain to yield inadequate and distorted data about human nature. In 1928, as a research fellow at Cambridge University, he had read Professor Barcroft's book "Lessons from High Altitudes" and had been much impressed by the alterations in mental and emotional processes incidentally mentioned in the account of various physiological experiments associated with reduction of oxygen pressure. He felt that a further study of these alterations promised to yield results of a psychophysiological nature and would be free from the sterile traditional approach of academic psychology.

His first experiment was planned with the help of Professor Barcroft and Professor F. C. Bartlett. The subjects were pilots from the Cambridge University Air Squadron, chosen because of their interest in the effects of oxygen want in high-altitude flying. From a 1,000-liter Douglas Bag, and over a period of one to two hours, the subjects breathed various oxygen mixtures corresponding to the percentages of oxygen available to the organism at different altitudes. During the exposure to oxygen lack, varying from 21 per cent concentration of oxygen (corresponding to sea level) to 9 per cent (corresponding roughly to 22,000 feet), the pilots were given a series of psychological tests in such matters as reaction time, recognition of spatial relations, motor co-ordination, memory, judgment, and emotional control. It soon became clear that when oxygen deprivation was carried far enough, the behavior of each pilot was profoundly altered. There was loss of judgment and control of mental functions, of memory for recent experiences and emotional stability. Temperamental traits became greatly accentuated, a fact which suggested that the experiment was unmasking or exposing certain basic aspects of behavior. Not only were the mental faculties impaired, but the pilot was often unaware that they were impaired. In fact he felt particularly well. He lost his capacity for self-criticism. This finding was interesting in light of the fact that some pilots have claimed that they are able to function effectively at very high altitudes.

One incident of the experiment will illustrate this point. "The handwriting of one subject was followed throughout a period of

one hour while the oxygen was gradually depleted. At a simulated altitude of 22,000 feet, he appeared to be quite pleased with himself and became highly amused at the slightest provocation, in spite of temporary blanks in the visual field. At 25,000 feet (8.7 per cent oxygen) he began to omit letters from common words, and his writing became quite illegible. He complained of his feet feeling a long way off and of his inability to orient other parts of his body. At 28,000 feet (7.6 per cent oxygen) he was greatly incapacitated and yet he appeared to be cheerful and very pleased with his performance. He became quite annoyed when removed from the apparatus and insisted that he could go much higher. He was convinced of his marked deterioration only after seeing his handwriting."

In many respects the behavior of sufferers from anoxia seemed to resemble that of mental patients or persons suffering from excessive amounts of alcohol or narcotics. Accordingly, several experiments were undertaken with this problem in mind. "In co-operation with Dr. Barach and the staff of the New York State Psychiatric Institute, a series of dementia praecox patients (catatonic syndrome) were placed in chambers with 50 per cent oxygen and 2 to 3 per cent carbon dioxide. These patients are often observed to be rapid, shallow breathers with some manifestation of oxygen want, such as cyanosis of the extremities, low metabolism, and alteration in the blood gases." The initial results with four patients were encouraging, but in the next series of ten patients, none was significantly improved after two months of the treatment. The experimenters felt that the patients selected for the study were too advanced, having been in the catatonic form of dementia praecox for six to eight years. "Nevertheless it was possible to produce periods of lucidity following recovery of consciousness after breathing excess amounts of oxygen and carbon dioxide (20 per cent CO_2 and 80 per cent O_2). . . . A disorder of the nature of dementia praecox is no doubt extremely complex and related to many variables. It is doubtful that any one factor, such as chronic or acute anoxia or, at the other extreme, psychological causes, will prove to be the most important variable. The results obtained thus far, however, suggest that anoxia in one form or another may be a contributing cause of the disorder."

The next experiment which Dr. McFarland discussed was carried out at Columbia University with patients from the Vanderbilt Clinic. In this investigation he was interested in studying psychoneurotics rather than psychotics, and he was especially interested in the class of psychoneurotics who complain of acute

exhaustion and fatigue, and who have some objective manifestations that may involve chronic oxygen want due to shallow breathing, low metabolism, and circulatory failure. The patients selected were of this class. Arrangements were made so that forty of them, together with a like number of control subjects, could be studied while breathing excess and deficient percentages of oxygen in chambers. "Each subject came to the laboratory once a week for a month so that he could be tested as follows: (1) control air—21 per cent O_2 (sea level); (2) 50 per cent O_2; (3) control air—21 per cent O_2; and (4) 10 per cent O_2 (20,000 feet). A series of physiological, biochemical, and psychological tests was given during each experimental session. Approximately 70 per cent of the psychoneurotics collapsed in the low oxygen series, while only 14 per cent of the controls were so markedly affected. Whether the cause of illness in these patients is psychological or physiological, there appears to be a significant amount of unfitness to account for their complaints of fatigue and exhaustion when they go through a period of chronic emotional stress. It is often suggested that these patients have impaired sympathetic nervous systems. These experiments offer some evidence for this view, since the mechanisms involved in adaptation to oxygen lack are related to the functions of the sympathico-adrenal system. Professor Cannon has reported that sympathectomized cats are more susceptible to oxygen want following the operation. It is a common observation among pilots that 'nervous' passengers are more susceptible to high altitude and more apt to faint. Normal subjects following the loss of sleep were also more sensitive to the effects of oxygen deprivation."

The fact has already been mentioned that the effects of acute oxygen want resemble the effects of alcohol. Indeed Van Slyke classifies alcoholism as a form of oxygen want (histotoxic). On the basis of this theory, Dr. McFarland and Dr. Barach planned an experiment to determine the effect of excess oxygen and carbon dioxide on subjects who had taken alcohol. The experimenters felt that with the results of such a study it might be possible to explain more adequately the action of alcohol on the nervous system and the resulting changes in behavior. Subjects were given small and large drinks of alcohol while breathing normal air in a chamber, and then while breathing excess percentages of oxygen and carbon dioxide. Blood samples were taken at intervals in order to determine the concentration of alcohol and lactic acid in the blood. In addition, the subjects took a series of sensory and mental tests during each experiment. The subjects tended to sober up more rapidly under excess percentages of oxygen and carbon dioxide, and they

did better in the psychological tests. The blood alcohol and the lactic acid tended, on the average, to be lower in the series of experiments with excess oxygen and carbon dioxide than in the control series in air.

These experiments were repeated by Dr. Forbes and Dr. McFarland during the High Altitude Expedition to the Chilean Andes. "Similar amounts of alcohol were ingested at 17,500 feet, at 12,200 feet, and at sea level. At constant intervals samples of venous blood were taken for the determination of the concentration of alcohol in the blood, and a series of psychological tests was given. The concentration of alcohol in the blood rose more rapidly and reached a higher level at high altitudes than at sea level. In one subject at 12,200 feet the concentration of alcohol in the blood twelve hours after taking the alcohol was three times as great as at sea level. The relative impairment in the psychological tests was also greater in the mountains compared with sea level after the ingestion of alcohol." These findings are obviously important in connection with the question of drinking among aircraft pilots.

An unusual opportunity for the study of all these problems was offered in 1935 by the International High Altitude Expedition, already mentioned, sponsored by the Harvard Fatigue Laboratory. Ten scientists, chiefly physiologists and biochemists, from universities in this country and abroad (five from the Fatigue Laboratory) spent three months in the Andes studying the effects of diminished pressure of oxygen on the blood, the circulation, the respiration, the metabolism, the brain, and the sense organs of the human body. "The data of the effects upon members of the expedition were compared with those of the effects upon permanent residents and native miners. In addition, sea-level animals like the sheep and the rabbit were compared with animals whose evolutionary origin was probably in the high altitude, such as the llama and the vicuna." These comparisons in man and in animals furnished the scientists with an excellent background for studying the more important variables involved in the adaptation to a diminished amount of oxygen in inspired air.

At Antofogasta, Chile, a train was equipped with a laboratory, sleeping accommodations, animal and kitchen care. The first observations were made at 9,200 feet, where the largest open pit copper mine in the world is situated, that of the Chile Exploration Company. The train was then taken to Ollague (12,000 feet) and later to Montt (15,400 feet). If the reader will compare this method of transportation with the work of climbing on foot with packs, he will understand what an ideal place was discovered for a high-alti-

tude expedition. From Montt, the equipment was transported by truck to a sulphur camp at 17,500 feet, where the superintendent allowed the members of the expedition to turn his house into a scientific laboratory.

The highest station was established at the summit of Mt. Aucanquilcha (at 20,140 feet) in a snow cavern constructed by members of the expedition with the aid of the sulphur miners. Contrary to expectations formed from the history of previous scientific expeditions, the most fit members of the party were able to live fairly comfortably at this height. At the main laboratory at 17,500 feet, nine of the ten members of the expedition had reasonably good health, and the majority enjoyed meals and kept up interest in work. The one man who became definitely ill carried on for several days before conceding defeat. Yet no matter how well some of the scientists adapted themselves to the altitude, the natives and the animals remained a striking contrast to organisms bred at sea level.

"The sulphur mining community at 'Quilcha is of interest since it forms the highest permanent community in the world. About 150 men live there all year with their wives and children. They attempted to establish the camp at 18,500 feet, nearer the mine, but they found it impossible to sleep and general deterioration set in. Now they live apparently quite comfortably at 17,500 feet and walk each day to the mine at 19,000 feet. In the evening after a long day's work (piecework) at the mine, the younger men play soccer until dark. The physiological and psychological characteristics of these men proved to be of unusual interest, and a number of commonly accepted theories about fatigue and human variability will have to be restated as a result of the findings of the expedition."

At the end of the summer spent in Chile, Dr. McFarland and Dr. Christensen carried out a number of experiments during trans-Andean airplane flights. Their interest was in observing whether the ingestion of ammonium chloride would counteract the ill effects of high altitude. "In good weather the average flight across the Andes is made at about 14,500 feet. If the air is rough, due to head winds, the flights are occasionally made as high as 17,000 to 18,000 feet. The pilots and each passenger are supplied with oxygen to counteract any ill effects. The initial reaction of going to a high altitude is overbreathing, as a result of the attempt to compensate for the oxygen lack. This causes an excessive amount of carbon dioxide to be blown off the lungs and upsets the acid-base equilibrium of the blood." The scientists reasoned that "if the blood could be made very acid with ammonium chloride, which is associated with underbreathing, the excessive ventilation might be diminished

and hence the effects of the altitude counteracted. The first experiment bore out the theory, for those who ingested the ammonium chloride fared better than those who had not. On the return flight, however, an unanticipated variable crept into the experiment. The plane encountered head winds and rough air, making it necessary to ascend to 16,500 feet during the flight over the highest mountains. Those who ingested the ammonium chloride were unusually nauseated and at that point the experiment was terminated. Although it may be true that ammonium chloride will heighten one's ceiling by 4,000 to 5,000 feet in smooth flying, no substance has yet been discovered which will prevent air sickness in very bumpy weather. Undoubtedly the most satisfactory way to prevent the ill effects of high altitude and bumpy weather is to use an airplane fuselage which will maintain sea-level pressure at high altitude. With this kind of equipment rapid ascents and descents can be made from altitudes (18,000 to 25,000 feet) great enough so that smooth air and clear weather can be obtained. The very painful effects in the ears from too rapid descents will be avoided by airplanes with such equipment. The preliminary tests with such planes have proved to be very successful."

A large number of experiments had been carried out in the mountains and in simulated high altitudes in chambers at sea level. The scientists of the Fatigue Laboratory were anxious to compare the results of these experiments with those of more extensive studies under actual flight conditions in aviation. In particular the trans-Pacific operations of the Pan-American clippers seemed interesting because it was reported that the airmen became quite fatigued after these long flights. In the summer of 1937, Dr. McFarland and Mr. H. T. Edwards of the Fatigue Laboratory made the flight from Alameda to China in order to carry out a thorough investigation of the physiological and psychological changes in the crew of eight airmen and in six passengers during a typical flight.

"At that time there were three Martin flying boats in the regular service between Alameda and Hong Kong—the China, Hawaii, and Philippine Clippers. More recently three of the new Boeing planes have been added to the service. One of these ships leaves Alameda every Wednesday at 3 p. m. and arrives in Honolulu the next morning at about 8:30 a. m., the time depending on the prevailing winds. Thus about 2,400 miles are covered in 17 hours. The only night flying throughout the trip occurs on this passage. The succeeding five days of flying, before Hong Kong is reached on the following Wednesday, are from eight to eleven hours in length, one day being lost on the international date line. The remaining stopovers are

at Midway, Wake, Guam, and Manila. The total flying time on the trip to Hong Kong and return was approximately 134 hours, 15,000 miles being covered at a mean altitude of 9,460 feet. The cruising altitude of these flying boats is approximately 8,000 feet."

The experiment was planned so that the scientists should be with the same crew of eight airmen throughout a typical flight. The crews are made up of a captain, first officer, one or two junior flight officers, navigator, engineer, radio man, and steward. These men were given a series of tests at sea level at Alameda, which were repeated (1) during each day's flight, (2) at the end of each flight, and (3) on the following morning before rising. This procedure was adhered to throughout the journey and provided a basis for calculating the amount of physiological and psychological deterioration.

The tests which were given included "(1) psychological tests for closeness of attention, immediate memory, quickness of recognizing the meanings of words exposed in a focal plane shutter apparatus, sensitivity to retinal stimulation, near point of accommodation, and ocular muscle balance; (2) physiological tests for heart rate, blood pressure, work output of the heart, and urine volume; and (3) biochemical tests for the tension of the oxygen and carbon dioxide in the lungs, the amount of oxygen in the arterial blood, the red cell count, the lactic acid, and the protein, carbohydrate, and fat metabolism. Additional experiments were carried out at 12,000 feet with and without oxygen to determine the advantages of inhaling oxygen at such altitudes." The scientists made frequent observations on themselves, as typical passengers, and on as many volunteers as could be secured among the other passengers. By these procedures the scientists from the Fatigue Laboratory carried out the most extensive investigation ever made of airmen during prolonged flights at high altitude.

The airmen resembled athletes just before an important competitive event and men acclimatized to high altitude. In the first place, as in an athlete before a game, there was a tendency toward polyuria (excess urination), especially in the airmen who had the greatest responsibilities. This tendency diminished as the flight got under way for several days. Secondly, the airmen had very high indices of neurocirculatory fitness, the average being approximately the same as in a group of college athletes. The relative increase of the pulse rate after exercise, however, tended to be higher as the flight progressed. Thirdly, like the acclimatized miners observed in Chile, the airmen tended to develop low blood pressures during the flight, with a more controlled heart output index during and after each flight than the passengers. "Fourthly, they maintained a higher

alveolar (lung) oxygen tension than the passengers, with a 10 to 15 per cent increase in red blood cells (oxygen carriers). Fifthly, the protein, carbohydrate, and fat metabolisms were normal, as well as the blood sugar and lactic acid. There was nothing in the blood chemistry to suggest excessive physiological fatigue or intense emotional excitement. Sixthly, the impairment in the psychological tests at high altitudes corresponded very closely to that which was observed at similar altitudes in the Andes."

On the whole, therefore, the scientists found that these airmen maintained a high degree of mental and physical fitness throughout the flight and that their repeated flights to high altitude gave rise to many of the characteristics of genuine acclimatization. "During the early stages of this transoceanic service, the fatigue and exhaustion were no doubt quite severe. Now that accurate navigation aids and flight predictions, adequate sleeping facilities and good food at the island stations have been provided, the flight is less fatiguing. Even more important is the fact that the operations have now become routine, and therefore the apprehension associated with the initial flights over such great distances and with such expensive equipment has become less extreme. As the nervous strain has worn off, the physical exhaustion has been greatly diminished. This does not imply, however, that the flight to China and back is not strenuous, involving no physical and nervous strain. On the contrary, it is a feat in modern exploration which demands human endurance and courage of the first order. The findings of the tests, however, did indicate quite clearly that these airmen were not seriously or dangerously impaired, nor was there sufficient deterioration to jeopardize the safety of the operation."

In studying the effects of alcohol or of oxygen want at high altitudes, it is hard to secure tests which reliably measure the amount of deterioration present. The tests for intoxication in automobile drivers clearly illustrate this point. The driver may be able to conceal his intoxication by exerting greater efforts in muscular co-ordination. In the same way, "the Schneider Index test of neuro-circulatory efficiency is given to pilots several times a year as a routine test of their efficiency for flying. The pilots discovered that this index penalizes a person with a rapid pulse. For this reason, they often got intoxicated the night before their examination, since a slow pulse rate frequently results from excessive alcohol. The rebreather test, which was given to pilots during the World War in classifying them for altitude fitness, was subject to the same experimental error in that the test took place so rapidly (20 to 30 minutes) that they could withstand the effects of oxygen want until just

previous to collapse. This gave the impression that they could tolerate very high altitudes (18,000 to 20,000 feet) for several hours, which has been shown to be quite false in more recent experiments."

Accordingly, the Fatigue Laboratory has been trying to develop more sensitive tests in vocational selection for aviation. Such tests have been combined with the application of fixed stresses, such as exercise on a treadmill or submission to oxygen deprivation. In this manner latent unfitness can often be detected which would otherwise go unnoticed. Studies have also been made in photographing the eye movements of subjects reading under reduced oxygen pressure. These delicate ocular adjustments are not under conscious control. "The procedure involves the photographing of a beam of light reflected from the cornea of each eye as it goes through the series of fixations in reading the lines of a printed page. The coordination between the two eyes, the number of fixations, etc., can be very precisely measured." By this procedure the scientists of the Fatigue Laboratory have been able to detect the initial effects of oxygen deprivation or alcohol, as well as the more accentuated impairment at various altitudes which a pilot might reach in flight. It has also been possible to detect latent ocular motor anomalies in supposedly normal subjects.

Finally, in 1936-37, Dr. McFarland and others carried out at Columbia University a series of experiments for the United States Bureau of Air Commerce on the effects of high-altitude flying upon the average passenger. The experiments were planned so as to test large groups of subjects (over 200) at various altitudes simulated in chambers at sea level. The object of the study was to determine the specific altitudes at which the effects are definite enough to bring about subjective discomfort, such as headaches, dizziness, nausea, etc., or impairment in psychological tests. An analysis was also made of other factors affecting the condition of passengers at high altitudes, particularly the rate of ascent, the length of exposure to altitude, and the characteristics of the individual, such as age and physical fitness. The findings indicated that at 10,000 to 12,000 feet there was a degree of psychological impairment sufficient to warrant the use of oxygen, especially in unfit passengers. Differences in the rate of ascent were also important, in that some subjects would collapse following a 15-minute ascent to 14,000 or 16,000 feet, but would adjust fairly well if taken to similar altitudes in one hour and 15 minutes. The older subjects, between 45 and 75 years of age, apparently adjusted to moderate oxygen lack as well as the younger ones between 17 and 30. This result may have been due to the more stabilized neurocirculatory systems of the older persons. The find-

ings of these experiments in chambers at sea levels were checked during actual flights at high altitudes in the routine transcontinental operations of commercial air lines.

Dr. McFarland pointed out that the investigations which he described were primarily concerned with the study of human problems from the point of view of pure science. Nevertheless, they were carefully selected so that the results might be of value to industry. The need of research of this kind is obvious. "In aviation, for example, there are hundreds of excellent books on the motors and the mechanical side of flying, but who can mention even one good book on the human machine in aviation? If the Bureau of Air Commerce is correct in saying that 80 to 90 per cent of the accidents are due to 'human error,' an experimental analysis of what constitutes pilot error and the human factor in this industry is certainly necessary." One obvious way of beginning such a study is to consider the effects of high altitudes, that is, lack of oxygen, on the nervous system as one of the most important factors, both from the biochemical and the psychological point of view, contributing to fatigue and errors of judgment. The problem of oxygen want serves also to illustrate the work of the Harvard Fatigue Laboratory, since it combines a basic problem in human biology and psychology with a wide applicability of results, first, to those who live in or venture to high altitudes, as in aviation or mining in mountainous regions; secondly, to clinical disorders where oxygen want is an important variable, as in pulmonary disorders, cardiac illness, anemia, and carbon monoxide poisoning; and finally, to normal men while at work or during exercise.

In the discussion which followed Dr. McFarland's remarks, one interesting story was told, which may well be repeated here. Some questions had been asked about the psychological changes which take place at high altitudes, whereupon Dr. Dill reported an incident from the High Altitude Expedition to Chile. Dr. Barron, a member of the expedition, was skeptical about finding any such changes. Dr. Barron was one of Dr. Dill's best friends, and while there had been arguments between other members of the party, these two had no arguments up to an altitude of 15,400 feet. But when the expedition reached 17,500 feet Barron and Dill awoke one morning after sleeping in the same room and continued a discussion of this question of psychological deterioration. For the first time Barron became rather bitter about it, and Dill pointed out to Barron that he (Barron) was proving Dill's side of the case.

At the Conference, Mr. James C. Edgerton, Airways Operation Specialist, Bureau of Air Commerce, United States Department of Commerce, spoke, like Dr. McFarland, on some of the problems raised by the development of aviation. His address was entitled "An Analysis of Pilot Fatigue." It is summarized in what follows.

Air transportation in America began with the formation of the air mail in 1918. At that time the pilot was perhaps 75 per cent and the machine 25 per cent of the total endeavor. The pilot found himself in a machine which as a means of staying in the air was often very inefficient and hard to maintain, and he discovered that he had to train certain senses in order to stay aloft. For example, he had to do contact flying; that is, he had to fly over a railway or a road, learn certain landmarks through painful experience, and fly by them. If he lost his contact with the ground and so lost guidance through the main sense of sight, he was in immediate difficulty. His instruments were insufficient to supplement his senses and enable him to go through.

Since that era, a series of developments has taken place in technique. The aircraft itself was improved. It increased in speed; it grew in size; power plants were perfected; and maintenance became systematized. In 1926 the United States Government asserted, in effect, that aviation was no longer an industry which required government support and fostering, but was able to maintain itself and become a regular medium of transportation. From that time, growth was rapid, and at the present time the airplane is a large machine with the prospect in the immediate future of having a passenger-carrying capacity of about forty. Cruising speeds are about 200 to 240 miles per hour—in terms of ground transport, four miles a minute or some 352 feet per second.

Navigation has improved in step with the development of the aircraft. The first effort was to supplement railroads, highways, and simple landmarks by placing lights at intervals of from five to ten miles along important routes. These lights were aids to the faculty of sight, but the pilot still found himself in serious difficulties if sight failed him. In 1920 radio had already been developed to some extent in broadcasting, and experiments had been performed in order to adapt radio to the peculiar problems of air navigation. The first tentative steps had been taken to find something to substitute for sight. At the present time the radio highway has eliminated the necessity of using the ground highway as a contact guide. The pilot has his radio beam, and through a system of signals he knows his position on that beam. He is also advised by radio communication as to conditions he may meet en route in the way of

adverse weather. But weather forecasting is not yet a satisfactory applied science, and weather sometimes presents conditions which seem to exceed man's capabilities. Besides radio, other instruments have been devised to supplement the pilot's sense in maintaining stable flight.

In making use of these new facilities, the pilot must read the indicators of a series of instruments on board the airplane. "These instruments supplement the sense of balance, the sense of equilibrium within the individual, so that by using his eyes and watching the instrument board he can tell the position of the airplane in relation to the surrounding atmosphere and the ground at any given instant." Thus in a case of zero-zero visibility, when the pilot may be flying through unusually bad weather conditions, in storms and clouds in which there is rain or snow, and may not be able to see the tips of his wings, his highway is still established through radio, and he knows the position of the three axes of his plane by means of his instruments.

These techniques have made unusual demands on the individual who uses them. For instance, there is a strange phenomenon involved in a pilot's trusting his instruments. When he is using the radio highway on instrument flying he must disregard powerful psychological reactions within himself. He may be flying on an absolutely even keel and performing an excellent job, but his senses tell him everything is wrong, that the plane is turned over on a longitudinal axis as much as 90 degrees and that he is performing a turn or some other maneuver. Therefore, it has been found necessary to put a pilot deliberately through a course of training which reveals to him in unmistakable terms that certain of his sensory perceptions must be disregarded. His senses are no longer accurate; they cannot chart the way for him in the new element. To perform his duties he must substitute mechanical appliances for sensory functions. Naturally, in these circumstances, psychological disturbances often appear. For one thing, a man who was trained in the old days of contact flying must now divest himself of all that he learned in his earlier training and substitute a brand new technique. In this field the machine age is making its greatest demands for adaptation on the part of the human organism.

What happens when a serious emergency occurs in the air? A plane is dispatched westbound over the mountains. The pilot finds good weather, and reports along the route are favorable; the forecast as to visibility is well within the allowance set up by the Bureau of Air Commerce. Nevertheless he may suddenly strike an unusual weather condition—a small freak pocket which develops high winds

with rain and snow—where he may lose his radio eye through rain, snow, or static. Such conditions may throw him back at once upon his own psychological resources, and the way he functions as an individual will make the difference between success and failure. The ratio has shifted back to that of the old days, in which the man on occasion was 70 to 80 per cent of the total endeavor and the machine only 20 per cent.

Obviously, it is vital to this new segment of industry, aviation, to know beforehand if possible how an individual will react in such a state of emergency. His reaction is governed by his physiological and psychological constitution. Accordingly the Bureau of Air Commerce has undertaken extensive physiological and psychological researches with the aid of Harvard and Columbia Universities. In aviation, man is in a new element and in a highly mechanized instrument which in many particulars can exceed the capabilities of the normal individual. The airplane can take a man so high that he suffers mental and physical impairment due to oxygen deprivation. Sudden changes in pressure on his body may produce serious consequences. For example, the discovery has been made that if the human ear is subjected to rapid pressure changes equal to only 200 millimeters of mercury, the effect becomes so painful that rotary vertigo and unbalanced equilibrium occur. The speed of a plane in displacement maneuvers can produce greater forces than the human body can tolerate. During maneuvers, when he is turning at speeds of about 180 miles an hour, a man weighing from 150 to 160 pounds will exert 1800 to 1900 pounds pressure on his seat. The column of blood from the heart to the brain may not be able to stand up under a force of five or six gravities, and he may suddenly suffer from anemia of the brain and "black-out." This sort of condition is often realized, for instance, in air races.

Nevertheless, experience and research seem to show that in determining his reaction to situations faced in flying, the psychological constitution of the individual is even more important than his physiological constitution. The problem of aviation then becomes one of the following sort: given a man who was born with certain psychological tendencies and has gone through certain kinds of experiences, what will he do when he is faced with a situation demanding a proper decision in a moment of emergency, when he is absolutely on his own and unable to depend on his instruments? Aviation must be able to predict. If it cannot, it may send a man out with forty passengers, he may encounter an emergency, and his reactions or lack of self-control may lead him to do the reverse of what he ought to have done.

In other words, man has manufactured a machine to which he is inferior so far as operating efficiency is concerned. To a certain extent, rules set up to govern his action overcome the difficulty. If a pilot discovers that he has lost his radio beam through static, he must return to his starting point. If he meets other insurmountable circumstances, he must return to a point which he knows is clear. But rules cannot be devised which will insure proper action in every emergency. Ultimately such action will depend on the good judgment of particular men, and what the aviation industry is trying to do is make sure that its pilots are the sort of men who will exercise good judgment. It is trying to devise physiological and psychological methods by which it will be able (1) to select the proper persons as pilots, (2) to maintain them at their maximum efficiency, and (3) to eliminate those who fall below an established level. Pilots must be absolutely normal men, physically, mentally, and spiritually. The industry is trying to find standards for choosing such men and determining whether they remain so. So far, it has been successful only in certain respects. Here is the problem of research in the human factor in aviation.

III. Some Industrial Causes of Illness

The reader will observe that the investigations reported here have been progressively less concerned with the physiological factors involved in the behavior of men in industry, and more concerned with the psychological factors. Of course, one of the findings common to all the investigations has been that the two are in fact intricately interrelated and can be separated only in abstraction. Nevertheless, Drs. Dill and McFarland were in general concerned with the problems of physiological unbalance, though they emphasized the fact that such unbalance may have psychological consequences. Mr. Edgerton, on the other hand, was chiefly concerned with the psychological factor, and reported that in determining the reaction of an airplane pilot in an emergency, his psychological constitution is more important than his physiological constitution. This trend was maintained in the next address made before the Conference. It was entitled "Some Industrial Causes of Illness" and was delivered by Dr. G. Canby Robinson, Lecturer in Medicine, School of Medicine, Johns Hopkins University, Baltimore, Maryland. It is summarized in what follows.

The health of industrial workers is an important field of medicine. For years much attention has been given to the problem of protecting workers against accidents and the injurious chemical and physical effects of the materials with which they work. Such industrial causes of illness are not the ones to which Dr. Robinson called attention. He was concerned rather with the injurious effects which may arise out of human relations in industry. Social contacts in industry, often close and constant, often unavoidable and formed without choice, are accompanied by emotional strain which may not only interfere with effective collaboration but lead to a marked decline in individual efficiency, and even to incapacity for work. The point can be crudely illustrated in the following way. Drs. Dill and McFarland were concerned first with organic unbalance and secondly with its psychological consequences. Dr. Robinson was concerned first with psychological unbalance and secondly with its organic consequences. The origin of unbalance differs, but unbalance eventually involves the whole organism.

Emotional strain is a common and unavoidable experience in

human contacts. We all know that human relations may produce annoyance, tension, and minor emotional disturbances. But emotion becomes harmful to the organism only when prolonged and repressed, and when exaggerated by social or personal maladjustments. Dr. Robinson's words were these: "There are many variables entering into the circumstances which produce emotional strain. There are many different causes and many types of human reactions to it. Emotions are harmful not because they occur, but because they are repressed, and for this reason superficial observation often fails to detect them. A more intimate method of study, as represented by the properly directed interview, is needed in order to reveal emotional strain."

Because many variables enter into the circumstances producing emotional strain, Dr. Robinson thought that there was little value in speaking in generalities. Accordingly he proposed to report three cases, each involving industrial workers and each showing the effect of emotional strain on working capacity and health. Each case would also show how strain may be relieved. The cases cited were perhaps extreme examples, in that the workers had to go so far as to seek medical care. Extreme or not, they are important, since reactions to emotional strain play a great part in the production of psychoneurosis, and psychoneurosis is the commonest form of chronic illness. It not only interferes with the efficiency and capacity of industrial workers, but is also responsible for the condition of the greatest number of unemployable persons within the age group to which industrial workers belong.

"The first case is that of a 39-year-old shoe worker who was admitted to the out-patient department of the Johns Hopkins Hospital on October 30, 1935, complaining of abdominal pains. His illness had begun with attacks of dull, nonradiating pain in the upper abdomen four years before, which had become constant and more severe two years later. Other symptoms occurred, including loss of appetite, and he had lost 20 pounds in weight. Previous to his attacks of pain the patient had always been a robust, healthy man, able to work hard for some years as a pipe-fitter and for the past 14 years as a shoe factory worker.

"When the patient was first interviewed in February, 1936, he had been extensively studied for four months, by careful physical examinations, laboratory procedures, x-ray and other instrumental methods. Nothing of a serious nature had been found, and his ailment was diagnozed as a mild, nonspecific, ulcerative colitis, probably secondary to a functional disturbance. He was treated with belladonna and other drugs.

"At the interview the patient appeared to be a rather earnest sensible man of the skilled workman type, who talked well but seemed to be rather 'high-strung' and anxious. He was an edge-trimmer by trade, skilled in a specialized process in shoe manufacture. He had worked at this process for 14 years, 7 years in his last place, and could make about $6 a day doing piecework. He seemed to have done well in his work, was a member of a committee running the 'inside' union, and said he had been on good terms with all the workers until about five years ago. Then a new superintendent was installed who was not an 'old hand' at the shoe trade but had the attitude of an 'efficiency man.' He did not work in harmony with the employees and was upsetting to some of them, but especially to the patient, who in six or eight months had developed an antagonism toward his superintendent because of what seemed to him 'nagging' and unfair methods. After talks with the superintendent, the patient would often have to stop work to 'cool off,' and although he never openly lost his temper or had any break in their relations, he would often feel nervous and out of sorts for three days after a discussion with his boss. At these times he began to have abdominal discomfort, which became more and more constant, culminating in the symptoms already described. Because of pain and loss of appetite he had to stop work in June 1935." The patient also reported that throughout his life he had had a tendency to lose his temper, and had done so occasionally to the point of "blind rage."

When interviewed in February, 1936, eight months after he stopped work, he was living with his wife and two children in a small three-room flat. His savings had been exhausted; he had moved four times to find cheaper rent, had borrowed money on his household goods, and was on public relief.

"After a second interview and a consultation with the doctors treating him, the situation was explained to the patient, and the relation of his symptoms to his emotional strain was pointed out. He was given assurance that his symptoms would clear up. As the patient was a good Catholic and a member of the Holy Name Society, a visit was made to his parish priest, to whom the situation was explained. The priest made a call immediately and not only gave the patient and his wife assurance but also arranged for the remittance of certain parochial school fees. The patient was gratified by the thought that his priest and his doctor were working together."

A few days later the patient came into the hospital to report that he had no pain for the first time in months. He was both

happy and surprised. But the end had not come yet. He was kept under observation over a year. His health became better or worse according to his ability to find work. An attempt was made to take him out of his highly specialized job, by finding him a position in a large manufacturing plant, but he was so badly handled by the personnel staff that the attempt was a failure and resulted only in a return of symptoms, which were relieved when he went back to shoe work. A shutdown in the shoe factory was accompanied by mild symptoms, but during the following summer, the patient was a foreman in a cannery, where he worked hard, running about all day, was entirely symptom-free, and said he felt like a boy again. Eventually he became re-established in the shoe trade, and when last seen was off relief, out of debt, and quite well. During the time he was under observation, he demonstrated repeatedly the relation of his symptoms to emotional strain and anxiety.

In this case, the interview revealed the emotional strain responsible for the patient's illness. The strain was directly referable to a social disturbance arising from his reaction to the circumstances of his work. The interview also indicated the procedures required for his treatment. After the psychogenic nature of his symptoms was established, he was given superficial psychotherapy, augmented by the co-operation of his priest, and made a good symptomatic recovery after an illness lasting about five years.

"A second patient, a 56-year-old woman, was admitted to the out-patient department on January 7, 1936, and found to have markedly elevated blood pressure and evidence of arterio-sclerosis. Her examination revealed evidence of emotional tension, venous engorgement, and some danger signs of circulatory failure.

"Although her medical history contained no record of definite subjective symptoms related to her disturbed circulation, a routine interview, followed by a home visit, brought out a different story. The patient had worked for nine years in the laundry of the Johns Hopkins Hospital. During the past four years she had been quite nervous and emotionally disturbed, and had felt almost constantly 'uncomfortable' while at work. Recently she felt much disturbed by the strain of her work, and for the past three months had been short of breath on exertion, so that she had to avoid a moderate grade on walking to work by taking a longer route at a slower pace. She also had a dread of going to work each morning.

"By going back into her work history, it was found that this patient lost her sense of well-being at the time when she was promoted four years before to be in charge of a process in the laundry requiring her to direct four assistants. The patient was unusually

conscientious and tried hard to keep the work speeded up and properly co-ordinated with other processes, but she was much annoyed by the young women who helped her, as they were inattentive and 'loafed on the job' when the superintendent was not about. She thought it was for this reason that the work was hard for her.

"The patient was a reliable, conscientious woman, who always kept her appointments and was unusually particular in carrying out directions. She had a good understanding of her situation, was sensible and unusually co-operative. She had a somewhat excitable temperament and had experienced severe emotional disturbances, as her first husband had been killed in a street accident a year after her marriage, and she had been married twice subsequently, both marriages ending in divorce after many disturbing episodes. It seemed probable that these experiences had made this women particularly susceptible to emotional strain, although she suppressed its effects consistently until it was brought out by direct inquiry.

"In order to observe the patient at work, a visit was made to the laundry, where she was seen working in front of a large flat-ironing machine which she was responsible for feeding, with three or four girl assistants, who appeared to have no special interest in their work. When the situation was discussed with the laundry superintendent, he said that she had recently been failing in her work, as she did not have the necessary authority over her assistants, who teased and laughed at her. He said a change of her position would be helpful to the work of the laundry, and agreed to put her in a place where she no longer had responsibility for other workers, although this could be done only with a reduction of wages. A plan was then made which was later explained to the patient as necessary for her health, and with some reluctance she agreed to a change which put her on the other side of the machine as an individual worker. This change of work was arranged with the idea that it would diminish the emotional strain, which would tend to lower her blood pressure and decrease the hazards of her work in regard to her circulation.

"One week after the change of work had been made she said with enthusiasm, 'A miracle has happened, and a big burden has been lifted from me.' The feeling of nervousness was gone; her neck, she said, was no longer swollen, and she was not short of breath. Soon thereafter she began to walk to her work up the grade that she had previously avoided. During the following year, when the patient was frequently observed, there was no return of symptoms. She continued to speak of the effects of her change in work as a 'miracle.' She worked steadily, took no drugs, and

gained 16 pounds in weight. She gave the impression of being a contented, happy person, which she claimed to be."

The point of special interest in this case is the almost sudden disappearance of symptoms when the worker was relieved of emotional strain. The social relations between her and the workers she was expected to control and direct had been uncomfortable. Her own conscientious spirit was in conflict with her young and inattentive assistants, and she was not able to impress her authority upon them. The worker had been under an emotional strain for about four years. It had begun to show itself in the production of symptoms, but these were fortunately relieved before serious consequences occurred in her health and working capacity.

The third and last case illustrates the effects of emotional strain inherent in the work of a street car operator. The patient was a 38-year-old man who had been in the employ of a street railway company for 18 years. For the first eight years he was a conductor, and then became a motorman. Shortly after his change of work, he was admitted to the dispensary with abdominal pains and other symptoms, which he said were worse if he worried. He also had a fear of pulmonary tuberculosis. He was thoroughly examined, being given among other things a series of x-ray examinations, and no evidence of organic disease was found. With reassurance and drugs he improved, and did not return for treatment until ten years later, in September, 1937. He then said that he had had his old trouble off and on during the interval of ten years, but that it had become worse about two years before, and during the last six months he had been losing weight. He had to be very careful in regard to his diet and was often kept awake at night by pain if he ate in the evening. He also described attacks of trembling, abdominal pain, and sweating, which came on during his work. He feared he had gall-bladder disease, as some of his friends had suggested, and said that he continued to worry about everything.

Again a careful examination by the staff of the gastro-intestinal clinic failed to reveal any organic disease. The patient was then interviewed on several occasions in an endeavor to find the basis of his symptoms. He was also visited at home. He had had a satisfactory boyhood on a Virginia farm, was happily married, owned the house in which he lived, and had no financial or family difficulties. He said, however, that he had always worried, just as his father had done, and gave other evidence of being a somewhat neurotic individual who seemed to be hyperconscientious. He said that his symptoms had been worse for the last two years, that is, ever since his superintendent, who treated him "like a son," had

suffered an attack of gall-bladder disease and died after an operation. The patient had kept this event constantly on his mind. He described the conditions of his work, which consisted in running a one-man street car through the most congested streets of Baltimore. He said that he became much upset at times when his car was delayed, and once when the street was congested because of a fire, and two passengers had complained severely to him, he left his car in disgust and walked off, but after having gone half a block he realized what he was doing and returned to his car. He was always anxious about being on time and avoiding accidents and had succeeded in going through the past year without an accident, while another man had as many as 45 during this time. His hours of work were satisfactory, but once a week he took a night run until 2 a. m. and had to report the next morning at 7 a. m., when he was usually nervous and upset.

After the first interview and home visit, the patient began to respond to explanations given to him regarding the relation between his symptoms and the strain of his work, and at the second interview he said that he had gained weight and that his attacks of trembling, pain, and sweating had been less frequent. He added, however, that he was now entering the hardest time of the year for him, because of falling leaves, which made it much harder to stop his car and added to the tension of his work. At the next interview he recounted only one bad spell. He had had a narrow escape from hitting an old woman, and this, his worst scare in six months, was followed by symptoms which compelled him to take an afternoon off. "At the fourth interview the patient said he had been entirely free from pain for two weeks, except for a brief attack for two to three minutes after coughing, and had eaten without restrictions and without discomfort. He said he had changed his attitude toward his work, as he had been told to do at each interview, and it seems that his sentiments regarding the management of a street car had been definitely influenced for his good. He claimed to be well for the first time in ten years, and it is fair to say that he looked a very different person from the man first seen about a month previously."

This man had a sensitive, neurotic makeup, but he was judged to be unusually reliable and useful in his position, although he needed particular handling to allow him to do his work at his best without undue emotional strain. The question of recommending a change of job was under consideration, but he responded to reassurance and mild psychotherapy so well that a change did not seem necessary; he could be fitted into his old work instead of having his work adjusted to him. In discussing this patient with one of his psychiatric

colleagues, Dr. Robinson was told that ten or twelve men, usually "old hands," had been seen in the psychiatric clinic; they had succumbed to emotional strain when the one-man street car was introduced into the transit system of Baltimore.

In the case of each of the three patients whose histories have been examined, the association of symptoms with conditions of work seems to be well established, if only because the symptoms were relieved when the emotional strains arising out of working conditions were brought to light, explained, and removed. It is obvious also that each of the patients had personal characteristics which made him particularly susceptible to the strains encountered in his work. But these industrial causes of illness and these personal characteristics are not taken into consideration by the usual type of hospital practice. Other methods are necessary. Observation of the worker on the job is the direct method of discovering the causes and effects of emotional strain. When this method cannot be used, the interview, supplemented by thorough medical study, will reveal the patient's reaction to his working conditions.

"Neither the direct observation of the worker on the job nor the interview directed to reveal working conditions is likely to be carried out by the doctor unless someone in daily contact with the worker suggests where the trouble may originate. The point has been recognized by the director of health of a large service company and deserves brief discussion. Dr. Leverett D. Bristol, Health Director of the American Telephone and Telegraph Company, has published a paper on the importance of the supervisor in the industrial health program,[1] in which he discusses the health responsibilities of supervisors under three heads: to stimulate the ideals of good health; to detect indications of potential ill health among employees; and to take proper action with regard to unsatisfactory conditions. Among the suggestions he makes regarding the detection of potential ill health, he says that poor quality of work, unsatisfactory mental attitude, and friction with other employees, particularly supervisory people, which cannot be traced to the commonplace events of the everyday working conditions, may indicate severe mental or nervous strain due to a multiplicity of causes which should be investigated. Bristol recommends that where practical and feasible, all supervisors or prospective supervisors should be taught the principles of mental hygiene in order that they may form wise mental habits of their own, and that they in turn may be proper guides to their working forces.

[1] L. D. Bristol, "Importance of the Supervisor in the Industrial Health Program," American Journal of Public Health, 26, 1083 (1936).

In this way the number of maladjusted supervisors and workers may be markedly reduced. He believes that if the working forces in industry are to become health-minded, the supervisory organization must assume the leadership, and that the industrial supervisor of the future must have a dual responsibility—that toward the actual work at hand and that toward and with the worker supervised, in order to promote not only individual safety but industrial health as well."

A number of difficulties would naturally arise in carrying out these suggestions, but in large industrial or service organizations with well-developed medical departments, the supervisors could be trained to act as the connecting link between the workers and the doctors. They could learn to observe the signs of emotional strain in their workers and to report their observations to the proper medical authority when their own efforts were ineffective. Efficient care of situations involving emotional strain might also require in an industrial medical service a special interest and training which may not now exist. In any event, well-trained social workers would have to augment the service. Nevertheless, Dr. Robinson felt that "the development of such a service would be of value to the company in elevating efficiency of work, in lessening turnover, and in combating industrial unrest by preventing the development of psychoneuroses. If such a service could be effectively developed, it would be of great value in the promotion of mental hygiene and happy lives among the workers and their families."

In small plants where health services do not exist, this plan could be carried out by other means, if its effectiveness were demonstrated in the large plants. But as a matter of fact it is probable that such schemes are carried out more effectively at present in some small plants than in the great industrial organizations. Dr. Robinson mentioned one intelligent chief engineer in charge of the whole mechanical and maintenance force of a large New York hotel who told him that "he had practically stopped the turnover in his department by a system of personal interviews with each member of his staff. He uncovered not only the unnecessary difficulties pertaining to the various jobs, but also learned of adverse social factors in the lives of his workers, and did what he could to adjust the workers to them or helped in their removal."

Special emphasis should be laid on the last paragraph of Dr. Robinson's remarks: "It is difficult to say how large a part adverse social conditions and maladjusted personalities in industry play in the development of the psychoneurosis with its great variety of physical manifestations, but it can be said that this type of disorder is the basis of more chronic illness than any other human dis-

turbance, and that intelligent efforts to learn the part industrial conditions play in its production are an important factor in preventive medicine and the improvement of industrial health. These efforts can only be made by greater knowledge of the worker as an individual."

In the discussion which followed Dr. Robinson's remarks, at least two important questions were raised. The first concerned the attitude of the workers themselves toward any such program of mental hygiene as Dr. Robinson proposed. One opinion was that workers tended to be suspicious of any efforts of the kind promoted from above, from the management. In this connection the following remarks of Louis I. Dublin, Vice-President of the Metropolitan Life Insurance Company, are important: "I should like to bring home to the group the attitude of organized labor to the institution of medical service in industry. This attitude, whether justified or not, is one of acute suspicion. I have in mind especially the effort to develop periodic health examinations as a function of the medical department in industry. Valuable as that service can be, and is in some places, the movement has been delayed and thwarted by organized labor on the ground that the examination is a subtle method of weeding out undesirable individuals from the shop. . . . It may be that the attitude is disappearing as industry and labor get together on more common ground, but I think that anyone knowing the industrial field would say that considerable suspicion still prevails."

The suggestion was made, by Walter S. Hunter, Chairman, Division of Anthropology and Psychology, National Research Council, that the problem of the psychoneurotic in industry could be met only by going outside of the regular medical unit of the industry. "The neurotic subject," he pointed out, "must have absolute confidence in the person with whom he talks, confidence that what he says will not be betrayed to the management." If a body outside of the regular medical service could be organized to take care of the problems arising from social maladjustments in industry, could not a solution be found? Left to itself, the regular medical service might be able to accomplish nothing. The countersuggestion was made at once that the training and attitudes of the regular medical officers might be changed. A statement of R. R. Sayers, Chief of the Division of Industrial Hygiene, National Institute of Health, is appropriate in this connection: "The confidence between doctor and patient is one of the tenets of ethics in industry just as anywhere else. As an example, in one of our large industries the doctor holds that if a foreman asks what is the matter with a man, the

reply is that 'he is sick'; that 'when he is able to work I will advise you, and advise you under what conditions.' He has maintained that attitude for about 35 years, and he has the full confidence of his men."

Conditions of course vary from industry to industry. Nevertheless, the attitude of an important group at the Conference could perhaps be summed up in these words of one of its members: "My experience is that the average workman is scared to death of the professional man in connection with anything that relates to his everyday, ordinary work."

Dr. Dublin raised a much more important question. He asked what attitude industry took toward the workman who is impaired physically or mentally. He pointed out that one solution which is commonly adopted is that of discharging the man because he is an economic loss. But such a person cannot be eliminated from the earth; he and his family are here and must be taken care of. The question arises whether industry has a definite responsibility to the impaired worker, and how great that responsibility is.

Dr. Dublin's question naturally aroused considerable discussion. One comment was that the question of the responsibility of industry was an important one, but that it could not be considered without considering also how far industry is able to meet the responsibility. Money spent on employees in one direction has to be taken away from them in another, and it is important to know the wishes of the employees themselves in the matter. Dr. Henderson, as Chairman of the Conference, suggested that the physiologists, psychologists, and industrialists who had been doing the work described at the Conference were little qualified to discuss the question of responsibility, that a number of social scientists had concerned themselves with such questions, and that the Conference should limit itself to its original program—a study of research in those fields not treated in established disciplines. Everyone, he pointed out, agrees that the world is in an uneasy state, but the whole history of science shows that progress is made by studying one thing at a time and then putting things together. The business of the Conference was that of discovering whether certain kinds of research have produced limited results that begin to be trustworthy and whether there is hope of further progress in similar directions. It was not that of producing a millenium, but of studying the means of improving the conditions of work in industry in so far as they fall within the professional competency of a body composed of specialists.

IV. The Western Electric Researches

Perhaps the most important program of research studied by the Committee is that which has been carried on at the Hawthorne (Chicago) Works of the Western Electric Company. This program was described by H. A. Wright and M. L. Putnam of the Western Electric Company and by F. J. Roethlisberger, Associate Professor of Industrial Research, Graduate School of Business Administration, Harvard University, particularly at a meeting of the Committee held on March 9, 1938. These men, together with Elton Mayo and G. A. Pennock, both members of the Committee, had been intimately associated with the research.[1]

A word about the Western Electric Company is a necessary introduction to what follows. This company is engaged in manufacturing equipment for the telephone industry. Besides doing this part of its work, it has always shown concern for the welfare of its employees. In the matter of wages and hours, it has maintained a high standard. It has provided good physical conditions for its employees; and it has tried to make use of every established method of vocational guidance in the effort to suit the worker to his work. The efforts of the company have been rewarded in good industrial relations: there has been no strike or other severe symptom of discontent for over twenty years. In short, there is no reason to doubt that while these researches were being carried out the morale of the company was high and that the employees, as a body, had confidence in the abilities and motives of the company management. These facts had an important bearing on the results achieved.

The program of research which will be described grew out of a study conducted at Hawthorne by the Western Electric Company in collaboration with the National Research Council, the aim of which was to determine the relation between intensity of illumination and efficiency of workers, measured in output. One of

[1] This research has been described in detail in a number of papers and in at least three books. The books are:

E. Mayo, "The Human Problems of an Industrial Civilization," The Macmillan Company, New York, 1933.

T. N. Whitehead, "The Industrial Worker," (2 vols.), Harvard University Press, Cambridge, 1938.

F. J. Roethlisberger and W. J. Dickson, "Management and the Worker," Harvard University Press, Cambridge, 1939.

the experiments made was the following: Two groups of employees doing similar work under similar conditions were chosen, and records of output were kept for each group. The intensity of the light under which one group worked was varied, while that under which the other group worked was held constant. By this method the investigators hoped to isolate from the effect of other variables the effect of changes in the intensity of illumination on the rate of output.

In this hope they were disappointed. The experiment failed to show any simple relation between experimental changes in the intensity of illumination and observed changes in the rate of output. The investigators concluded that this result was obtained, not because such a relation did not exist, but because it was in fact impossible to isolate it from the other variables entering into any determination of productive efficiency. This kind of difficulty, of course, has been encountered in experimental work in many fields. Furthermore, the investigators were in agreement as to the character of some of these other variables. They were convinced that one of the major factors which prevented their securing a satisfactory result was psychological. The employees being tested were reacting to changes in light intensity in the way in which they assumed that they were expected to react. That is, when light intensity was increased they were expected to produce more; when it was decreased they were expected to produce less. A further experiment was devised to demonstrate this point. The light bulbs were changed, as they had been changed before, and the workers were allowed to assume that as a result there would be more light. They commented favorably on the increased illumination. As a matter of fact, the bulbs had been replaced with others of just the same power. Other experiments of the sort were made, and in each case the results could be explained as a "psychological" reaction rather than as a "physiological" one.

This discovery seemed to be important. It suggested that the relations between other physical conditions and the efficiency of workers might be obscured by similar psychological reactions. Nevertheless the investigators were determined to continue in their course. They recognized the existence of the psychological factors, but they thought of them only as disturbing influences. They were not yet ready to turn their attention to the psychological factors themselves. Instead, they were concerned with devising a better way of eliminating them from the experiments, and the experiments they wanted to try by no means ended with illumination. For instance, there was the question of what was called "fatigue." Little

information existed about the effect on efficiency of changes in the hours of work and the introduction of rest pauses. The investigators finally came to the conclusion that if a small group of workers was isolated in a separate room and asked to co-operate, the psychological reaction would in time disappear, and they would work exactly as they felt. That is, changes in their rate of output would be the direct result of changes in their physical conditions of work and nothing else.

The decision to organize such a group was in fact taken. A small number of workers was to be selected and placed in a separate room, where experiments were to be made with different kinds of working conditions in order to see if more exact information could be secured. Six questions were asked by those setting up the experiment. They were the following:

1. Do employees actually get tired out?
2. Are rest pauses desirable?
3. Is a shorter working day desirable?
4. What is the attitude of employees toward their work and toward the company?
5. What is the effect of changing the type of working equipment?
6. Why does production fall off in the afternoon?

It is obvious that several of these questions could be answered only indirectly by the proposed experiment, and several of them touched upon the "psychological" rather than the "physiological" factors involved. Nevertheless, all of them arose out of the bewilderment of men of experience faced with the problem of dealing with fellow human beings in a large industrial organization. In fact, one of the executives of the company saw the purpose of the experiment in even simpler and more general terms. He said that the experiment grew out of a desire on the part of the management to "know more about our workers." In this way began the experiment which is referred to as the Relay Assembly Test Room. With this experiment and the others that followed, members of the Department of Industrial Research of the Graduate School of Business Administration, Harvard University, came to be closely associated.

In April, 1927, six girls were selected from a large shop department of the Hawthorne works. They were chosen as average workers, neither inexperienced nor expert, and their work consisted of the assembling of telephone relays. A coil, armature, contact springs, and insulators were put together on a fixture and secured in position by means of four machine screws. The operation at

that time was being completed at the rate of about five relays in six minutes. This particular operation was chosen for the experiment because the relays were being assembled often enough so that even slight changes in output rate would show themselves at once on the output record. Five of the girls were to do the actual assembly work; the duty of the sixth was to keep the others supplied with parts.

The test room itself was an area divided from the main department by a wooden partition eight feet high. The girls sat in a row on one side of a long workbench. The bench and assembly equipment were identical with those used in the regular department, except in one respect. At the right of each girl's place was a hole in the bench, and into this hole she dropped completed relays. It was the entrance to a chute, in which there was a flapper gate opened by the relay in its passage downward. The opening of the gate closed an electrical circuit which controlled a perforating device, and this in turn recorded the completion of the relay by punching a hole in a tape. The tape moved at the rate of one-quarter of an inch a minute and had space for a separate row of holes for each operator. When punched, it thus constituted a complete output record for each girl for each instant of the day. Such records were kept for five years.

In this experiment, then, as in the earlier illumination experiments, great emphasis was laid on the rate of output. A word of caution is needed here. The Western Electric Company was not immediately interested in increasing output. The experiments were not designed for that purpose. On the other hand, output is easily measured, *i.e.*, it yields precise quantitative data, and experience suggested that it was sensitive to at least some of the conditions under which the employees worked. Output was treated as an index. In short, the nature of the experimental conditions made the emphasis on output inevitable.

From their experience in the illumination experiments, the investigators were well aware that factors other than those experimentally varied might affect the output rate. Therefore arrangements were made that a number of other records should be kept. Unsuitable parts supplied by the firm were noted down, as were assemblies rejected for any reason upon inspection. In this way the type of defect could be known and related to the time of day at which it occurred. Records were kept of weather conditions in general and of temperature and humidity in the test room. Every six weeks each operator was given a medical examination by the company doctor. Every day she was asked to tell how many hours she had

spent in bed the night before and, during a part of the experiment, what food she had eaten. Besides all these records, which concerned the physical condition of the operators, a log was kept in which were recorded the principal events in the test room hour by hour, including among the entries snatches of conversation between the workers. At first these entries related largely to the physical condition of the operators: how they felt as they worked. Later the ground they covered somewhat widened, and the log ultimately became one of the most important of the test room records. Finally, when the so-called Interviewing Program was instituted at Hawthorne, each of the operators was interviewed several times by an experienced interviewer.

The girls had no supervisor in the ordinary sense, such as they would have had in a regular shop department, but a "test room observer" was placed in the room, whose duty it was to maintain the records, arrange the work, and secure a co-operative spirit on the part of the girls. Later, when the complexity of his work increased, several assistants were assigned to help him.

When the arrangements had been made for the test room, the operators who had been chosen to take part were called in for an interview in the office of the superintendent of the Inspection Branch, who was in general charge of the experiment and of the researches which grew out of it. The superintendent described this interview as follows: "The nature of the test was carefully explained to these girls and they readily consented to take part in it, although they were very shy at the first conference. An invitation to six shop girls to come up to a superintendent's office was naturally rather startling. They were assured that the object of the test was to determine the effect of certain changes in working conditions, such as rest periods, midmorning lunches, and shorter working hours. They were expressly cautioned to work at a comfortable pace, and under no circumstances to try and make a race out of the test." This conference was only the first of many. Whenever any experimental change was planned, the girls were called in, the purpose of the change was explained to them, and their comments were requested. Certain suggested changes which did not meet with their approval were abandoned. They were repeatedly asked, as they were asked in the first interview, not to strain but to work "as they felt."

The experiment was now ready to begin. Put in its simplest terms, the idea of those directing the experiment was that if an output curve was studied for a long enough time under various changes in working conditions, it would be possible to determine which con-

ditions were the most satisfactory. Accordingly, a number of so-called "experimental periods" were arranged. For two weeks before the operators were placed in the test room, a record was kept of the production of each one without her knowledge. In this way the investigators secured a measure of her productive ability while working in the regular department under the usual conditions. This constituted the first experimental period. And for five weeks after the girls entered the test room no change was made in working conditions. Hours remained what they had been before. The investigators felt that this period would be long enough to reveal any changes in output incidental merely to the transfer. This constituted the second experimental period.

The third period involved a change in the method of payment. In the regular department, the girls had been paid according to a scheme of group piecework, the group consisting of a hundred or more employees. Under these circumstances, variations in an individual's total output would not be immediately reflected in her pay, since such variations tended to cancel one another in such a large group. In the test room, the six operators were made a group by themselves. In this way each girl received an amount more nearly in proportion to her individual effort, and her interests became more closely centered on the experiment. Eight weeks later, the directly experimental changes began. An outline will reveal their general character: Period IV: two rest pauses, each five minutes in length, were established, one occurring in midmorning and the other in the early afternoon. Period V: these rest pauses were lengthened to ten minutes each. Period VI: six five-minute rests were established. Period VII: the company provided each member of the group with a light lunch in the midmorning and another in the midafternoon, accompanied by rest pauses. This arrangement became standard for subsequent Periods VIII through XI. Period VIII: work stopped a half-hour earlier every day—at 4:30 P.M. Period IX: work stopped at 4 P.M. Period X: conditions returned to what they were in Period VII. Period XI: a five-day work week was established. Each of these experimental periods lasted several weeks.

Period XI ran through the summer of 1928, a year after the beginning of the experiment. Already the results were not what had been expected. The output curve, which had risen on the whole slowly and steadily throughout the year, was obviously reflecting something other than the responses of the group to the imposed experimental conditions. Even when the total weekly output had fallen off, as it could hardly fail to do in such a period as Period XI, when the group was working only five days a week, daily output

continued to rise. Therefore, in accordance with a sound experimental procedure, as a control on what had been done, it was agreed with the consent of the operators that in experimental Period XII a return should be made to the original conditions of work, with no rest pauses, no special lunches, and a full-length working week. This period lasted for twelve weeks. Both daily and weekly output rose to a higher point than ever before: the working day and the working week were both longer. The hourly output rate declined somewhat but it did not approach the level of Period III, when similar conditions were in effect.

The conclusions reached after Period XII may be expressed in terms of another observation. Identical conditions of work were repeated in three different experimental periods: Periods VII, X, and XIII. If the assumptions on which the study was based had been correct, that is to say, if the output rate were directly related to the physical conditions of work, the expectation would be that in these three experimental periods there would be some similarity in output. Such was not the case. The only apparent uniformity was that in each experimental period output was higher than in the preceding one. In the Relay Assembly Test Room, as in the previous illumination experiments, something was happening which could not be explained by the experimentally controlled conditions of work.

There is no need here to go into the later history of the test room experiment, which came to an end in 1933. It is enough to say that the output of the group continued to rise until it established itself on a high plateau from which there was no descent until the time of discouragement and deepening economic depression which preceded the end of the test. The rough conclusions reached at the end of experimental Period XII were confirmed and sharpened by later research. T. N. Whitehead, Associate Professor of Business in the Graduate School of Business Administration, Harvard University, has made a careful statistical analysis of the output records. He shows that the changes which took place in the output of the group have no simple correlation with the experimental changes in working conditions. Nor can they be correlated with changes in other physical conditions of which records were kept, such as temperature, humidity, hours of rest, and changes of relay type. Even when the girls themselves complained of mugginess or heat, these conditions were not apparently affecting their output. This statement, of course, does not mean that there is never any relation between output rate and these physical conditions. There is such a thing as heat prostration. It means only that, within the limits

in which these conditions were varying in the test room, they apparently did not affect the rate of work.

The question remains: With what facts, if any, can the changes in the output rate of the operators in the test room be correlated? Here the statements of the girls themselves are of the first importance. Each girl knew that she was producing more in the test room than she ever had in the regular department, and each said that the increase had come about without any conscious effort on her part. It seemed easier to produce at the faster rate in the test room than at the slower rate in the regular department. When questioned further, each girl stated her reasons in slightly different words, but there was uniformity in the answers in two respects. First, the girls liked to work in the test room; "it was fun." Secondly, the new supervisory relation or, as they put it, the absence of the old supervisory control, made it possible for them to work freely without anxiety.

For instance, there was the matter of conversation. In the regular department, conversation was in principle not allowed. In practice it was tolerated if it was carried on in a low tone and did not interfere with work. In the test room an effort was made in the beginning to discourage conversation, though it was soon abandoned. The observer in charge of the experiment was afraid of losing the co-operation of the girls if he insisted too strongly on this point. Talk became common and and was often loud and general. Indeed, the conversation of the operators came to occupy an important place in the log. T. N. Whitehead has pointed out that the girls in the test room were far more thoroughly supervised than they ever had been in the regular department. They were watched by an observer of their own, an interested management, and outside experts. The point is that the character and purpose of the supervision were different and were felt to be so.

The operators knew that they were taking part in what was considered an important and interesting experiment. They knew that their work was expected to produce results—they were not sure what results—which would lead to the improvement of the working conditions of their fellow employees. They knew that the eyes of the company were upon them. Whitehead has further pointed out that although the experimental changes might turn out to have no physical significance, their social significance was always favorable. They showed that the management of the company was still interested, that the girls were still part of a valuable piece of research. In the regular department, the girls, like the other employees, were in the position of responding to changes the source and purpose of which

were beyond their knowledge. In the test room, they had frequent interviews with the superintendent, a high officer of the company. The reasons for the contemplated experimental changes were explained to them. Their views were consulted and in some instances they were allowed to veto what had been proposed. Professor Mayo has argued that it is idle to speak of an experimental period like Period XII as being in any sense what it purported to be—a return to the original conditions of work. In the meantime, the entire industrial situation of the girls had been reconstructed.

Another factor in what occurred can only be spoken of as the social development of the group itself. When the girls went for the first time to be given a physical examination by the company doctor, someone suggested as a joke that ice cream and cake ought to be served. The company provided them at the next examination, and the custom was kept up for the duration of the experiment. When one of the girls had a birthday, each of the others would bring her a present, and she would respond by offering the group a box of chocolates. Often one of the girls would have some good reason for feeling tired. Then the others would "carry" her. That is, they would agree to work especially fast to make up for the low output expected from her. It is doubtful whether this "carrying" did have any effect, but the important point is the existence of the practice, not its effectiveness. The girls made friends in the test room and went together socially after hours. One of the interesting facts which has appeared from Whitehead's analysis of the output records is that there were times when variations in the output rates of two friends were correlated to a high degree. Their rates varied simultaneously and in the same direction—something, of course, which the girls were not aware of and could not have planned. Also, these correlations were destroyed by such apparently trivial events as a change in the order in which the girls sat at the workbench.

Finally, the group developed leadership and a common purpose. The leader, self-appointed, was an ambitious young Italian girl who entered the test room as a replacement after two of the original members had left. She saw in the experiment a chance for personal distinction and advancement. The common purpose was an increase in the output rate. The girls had been told in the beginning and repeatedly thereafter that they were to work without straining, without trying to make a race of the test, and all the evidence shows that they kept this rule. In fact, they felt that they were working under less pressure than in the regular department. Nevertheless, they knew that the output record was considered the most important

of the records of the experiment and was always closely scrutinized. Before long they had committed themselves to a continuous increase in production. In the long run, of course, this ideal was an impossible one, and when the girls found out that it was, the realization was an important element of the change of tone which was noticeable in the second half of the experiment. But for a time they felt that they could achieve the impossible. In brief, the increase in the output rate of the girls in the Relay Assembly Test Room could not be related to any changes in their physical conditions of work, whether experimentally induced or not. It could, however, be related to what can only be spoken of as the development of an organized social group in a peculiar and effective relation with its supervisors.

Many of these conclusions were not worked out in detail until long after the investigators at Hawthorne had lost interest in the Relay Assembly Test Room, but the general meaning of the experiment was clear at least as early as Period XII. A continuous increase in productivity had taken place irrespective of changing physical conditions of work. In the words of a company report made in January, *1931*, on all the research which had been done up to that date: "Upon analysis, only one thing seemed to show a continuous relationship with this improved output. This was the mental attitude of the operators. From their conversations with each other and their comments to the test observers, it was not only clear that their attitudes were improving but it was evident that this area of employee reactions and feelings was a fruitful field for industrial research."

At this point the attention of the investigators turned sharply from the test room to the regular shop department from which the girls had come. Why was the mental attitude of the girls different in the test room from what it had been in the department? In their conversations with one another and in their comments to the observers, the girls were full of comparisons between the test room and the department, very much to the disadvantage of the latter. They felt relief from some form of constraint, particularly the constraint of supervision. They were exceedingly disparaging about the supervisors in the department, although management felt that the department had particularly good supervisory personnel. These facts suggested that the management of the company really knew very little about the attitudes which employees took toward conditions in the plant and very little also about what constituted good supervisory methods. Such was the atmosphere in which the so-called Interviewing Program, the third phase of the work at Haw-

thorne, was planned. So far the interests of the investigators had been centered on the question of what were good physical conditions of work. Now they shifted definitely in the direction of a study of human relations.

Briefly, the new plan called for interviewing a much larger group of employees than any hitherto studied, with the object of learning more about their feelings and attitudes. A beginning was to be made in the Inspection Branch, representing about 1,600 skilled and unskilled employees in both shop and office work. In the report of January, 1931, the investigators stated that their purposes had been the following: "First, we wanted to know how employees felt about their work and the way they were treated; second, we desired to learn the manner in which the company policies were being applied and employees' reactions to them; third, we were hopeful that something would come out of these employee expressions which could be used to develop and improve the training of supervisors."

The supervisors in the Inspection organization were called together, and the project was described to them. Their criticism was invited, and various points in the plan were discussed at this meeting. Five interviewers were chosen from among the supervisors to conduct the interviews. Women were selected to interview women, and men to interview men. The interviewers were not to interview employees whom they knew, since their acquaintanceship might influence what was said. In particular, it was obvious that no one should interview any worker over whom he had administrative authority. Records of the interviews were to be kept, and comments on the working situation were to be set down as nearly verbatim as possible, but all records were to be confidential. The names of the persons interviewed were not to be associated with the records, and any identifying statements were to be omitted. This rule was kept so well that it limited the usefulness of the records. It meant that the details of particular interviews could not be put together to give a picture of an entire working group or department.

In accordance with these plans, the interviewing of employees in the Inspection organization was begun in September, 1928, a year and a half after the beginning of the Relay Assembly Test Room experiment. It was completed early in 1929. So favorable were the results that the decision was made to extend the program to the Operating Branch. For this purpose, the Division of Industrial Research was organized on February 1, 1929, with functions which were stated as follows:

"1. To interview annually all employees to find out their likes and dislikes relative to their working status.
"2. To study the favorable and unfavorable comments of employees.
   a. To initiate correction or adjustment of causes of unfavorable comments.
   b. To determine upon benefits to be derived from favorable comments and to instigate ways and means of acquiring these benefits.
"3. To conduct supervisory training conferences for all supervisors using employee interviews as a basis.
"4. To conduct test studies relative to employee relations, fatigue and efficiency."

Obviously a program which called for interviewing annually all employees in a plant in which some 40,000 persons were then working was an ambitious one, and the event showed that it could not be carried through. At the time when the Industrial Research Division was formed, interviews required on the average about a half-hour each. Later, as a result of improvements in the technique of interviewing, they became three times as long. This change alone cut down severely the number of employees who could be interviewed. Nevertheless, in the three years 1928-1930, 21,126 employees were interviewed, more than half of them in the Operating Branch, the rest scattered through other parts of the Hawthorne Works.

The original interviewers had been five in number. The extension of the program made necessary an increase in the staff. For the most part, the new interviewers were chosen from the various branches in which the work was already in progress. In rank they were usually supervisors, and they were taken from their ordinary assignments for a temporary period of about a year. The belief was that such supervisors, with proper instruction, could undertake the interviewing, and that the interviewing experience could be made an important part of their training. Accordingly, as many supervisors as possible were to take part in the work. Besides this temporary personnel, a nucleus staff of permanent investigators was built up, whose duty was to train the new men and take over the more technical aspects of the work, in particular the analysis of the growing body of interview material. The approximate average number of employees involved in the interviewing and analyzing work during 1929 and 1930 was thirty for interviewing and six for analyzing.

The results of the Interviewing Program were interesting from

the first. The program was received with enthusiasm by both supervisors and operators. "This is the best thing the Company ever did" and "The Company ought to have done this long ago" were the sort of comments commonly encountered. The employees seemed to enjoy the opportunity of expressing their thoughts. They felt some kind of release, as if feelings which had long been pent up within them had at last found an outlet. Requests for interviews were received, some from the supervisors themselves. Accordingly, the interviewing was extended beyond its original bounds to group and section chiefs, that is, those supervisors immediately in charge of the rank and file.[1] In the course of their interviews, these supervisors were asked what they thought of the program and its effect. They were in its favor. They felt that it had not embarrassed them, that the employees liked it, and that it ought to be kept up and extended.

Evidence soon accumulated that the interviews not only gave expression to attitudes hitherto pent up but also, in giving them expression, changed them. The report of 1931 explained this rather unexpected result by an analogy: "It has long been known that one who writes a memorandum greatly clears his thought upon the material to be presented. Exaggerations, distortions, emotional reactions, defenses, etc., are largely dissolved when thus viewed objectively. In a similar way employees who express their thought and feeling to a critical listener discharge emotional and irrational elements from their minds. Many personal and individual problems and attitudes have been improved by the verbal expression which the interview affords. Taking account of the employee expressions recorded in twenty thousand interviews, we feel that this value in interviewing cannot be lightly overlooked."

The observation has been made, perhaps too cynically, that in building up good industrial relations it makes little difference what measures are taken to improve working conditions as long as the rank and file realize what the purpose of the measures is. The important factor is the conviction of the workers that the management is concerned about their welfare. Something of this sort Whitehead had in mind when he said of the Relay Assembly Test Room that, though the experimental changes might turn out to have no physical significance, their social significance was always favorable. In the same way in the Interviewing Program, the discovery that

[1] The name "supervisor" is often given at Hawthorne to all ranks of supervision above the worker. The first-line supervisor, in direct contact with the operators, is the group chief. The three ranks above him are section chief, assistant foreman, and foreman. A foreman is in charge of a department.

management was taking an interest in what they thought and felt was new and stimulating for many of the employees. It may be well to repeat here that the Western Electric Company has had a long record of intelligent treatment of its workers, which is reflected in the confidence the workers have in the Company. Without this confidence many of the results of the investigations at Hawthorne could not have been achieved. At the same time the investigations strengthened this confidence.

The effect of the Interviewing Program on the supervisors was not less interesting. The opinion of the management was that supervision improved almost simultaneously with the beginning of interviewing. This improvement was not the result of fear on the part of supervisors that their methods would be disclosed and shown to be faulty. There was apparently no such fear. It was the result rather of an increased knowledge of and interest in workers as individuals and an increased interest in the method of supervision which came from the knowledge that it was being made a subject for research. The records of the interviews were used as illustrative material for the training of supervisors and for conferences on supervision. An effort was made to see that as many supervisors as possible should have temporary experience as interviewers. Those who took part felt that they acquired a new understanding of the human problems of industry and, not less important, a new understanding of themselves. In fact the two must go together in any study of human behavior. A man can carry his analysis of other men no further than he has carried his analysis of himself. Finally, the men who were most closely associated with the Interviewing Program felt great enthusiasm for the work. They felt that they were acquiring new understanding, that they were free to move wherever the facts led them, and that in the end they would come out with something useful. The Chairman of the Committee pointed out that there seemed to be the same disinterested curiosity among the investigators as there is in any scientific research laboratory when the work is going well.

The investigators came away from the Relay Assembly Test Room with the feeling that management really knew very little about what constituted good supervision or what the employees thought about their conditions of work. The Interviewing Program was designed to provide such knowledge. It is significant that, in the original plan for the interviews, orders were given that comments on the working situation were to be recorded as nearly verbatim as possible. This material was the sort which was supposed to be important. The interviewers went to their early interviews

with something like a series of questions in their heads which they expected the employees to answer. The questions concerned such matters as working conditions, job, supervision, and so forth. The interview was to consist in effect of a series of answers to these questions. It is true that the interviewers were cautioned against putting these questions directly to the person being interviewed. Instead they were to enter into conversation with the employee and lead him around to the appropriate subjects only as opportunity served. Nevertheless the questions existed. Unfortunately for this plan, the discovery was soon made that a series of questions did not form a satisfactory basis for an interview. Questions did produce opinions, but the opinions were of unequal value. For one thing, comments on persons were less likely to produce information on which action could be based than were comments on material conditions of work. Whenever a number of employees working in the same neighborhood complained of cold, smoke and fumes, insufficient locker space, or some other physical source of irritation, an investigation could be made. In many instances the complaints were found to be justified and the conditions were corrected. But complaints about persons and about supervision in general usually had to be disregarded. Investigation showed that they had more reference to the attitudes people took toward situations than to the situations themselves.

An example, of a rather extreme type, will show what this statement means. An employee complained in an interview of one of her supervisors. Complete analysis of the case showed that the supervisor reminded her of a hated stepfather. Her attitude toward the supervisor was conditioned by that fact. In short, the experience of interviewing soon showed that many of the employees' comments, to them the most important, were to be taken as neither true nor false. They were expressions of the attitudes taken by particular persons in particular situations rather than statements of objective truth.

This conclusion led to changes in the method of recording the interviews. To quote once more from the report of 1931: "The original method had been to group employee comments under the heads of working conditions, job, and supervision, with the subclassification of likes and dislikes under each. This form was supplanted in 1929 because it was found, in attempting to analyze employee comments, that when their expressions were removed from their context they read very similarly and were often meaningless. The method adopted was to reproduce the interview as nearly verbatim as possible, showing both the comments made by

the interviewer and those made by the employee. This change had the effect of greatly lengthening the report (from an average of 2½ pages to an average of 10). Furthermore, it somewhat reduced the number of interviews which could be taken by one interviewer, thereby increasing the cost of each interview secured. The added value is that by this means all of the original values of the interviews are preserved and not merely those selected by the first form of analysis."

Another experience of the early interviews was the following. The interviewer would succeed in getting the employee to talk about a particular subject or subjects, but in a few minutes he would be completely off the point. Then the interviewer would try to lead him back, and again he would revert to the topic of his own choosing. It was all very well for the interviewer to have in his mind a set of questions which he hoped to get the employee to answer. Most of them seemed of no importance to the employee, and the answers the interviewer got were at best perfunctory. "It became obvious to the interviewers that, whatever the question, the thoughts of some employees tended to gravitate toward a particular condition or subject; that in these cases something was uppermost in the mind of the employee which completely overshadowed everything else. Cases were found where several subjects predominated in the mind of the employee, and any attempts to lead him away from his line of thought were generally unsuccessful. In other instances the interviewers found that a particularly untalkative person became remarkably communicative if just the right spot could be touched in conversation." These experiences naturally led the interviewers to ask themselves a number of questions. Was there any good reason why they should try, as they had been trying, to lead the employee back to the subjects which they (the interviewers) had particularly in mind? Why should they talk about the matters which were important to them rather than the matters which obviously were important to the employee? Was an employee's preoccupation with a particular subject to be disregarded as a mental aberration or exploited as a latent source of information in the matter of human relations?

Granted it was mental aberration, should it be disregarded even then? The heavy preoccupation characteristic of the thinking of some of the employees struck the investigators by its resemblance to the mental ill called obsession by Pierre Janet and the French School, compulsion neurosis by Freud and his followers. Obsession is a mental ill in the sense that its cause is apparently not physical. It does not arise from any pathological, organic condition, and in

some instances it is clearly curable by re-education or psychological "analysis." Furthermore it differs from hysteria, which may be a mental ill in the same sense, in that its symptoms as well as its causes are mental rather than physical. Hysteria manifests itself in amnesias and also, characteristically, in paralyses and anesthesias; this is not the case in obsession. The chief characteristics of obsession are described in the names given it. The patient is literally besieged, obsessed, by certain ideas; he is compelled to return to them again and again even though he may realize that they are irrational or untrue. He suffers from an inability to control his reflective thinking. This does not mean that he makes no effort to control it. On the contrary, he makes a great effort, but the more he tries the more he fails. With obsessive thinking may go obsessive acts. The patient finds it hard to begin any simple action. He finds it hard to make up his mind. He suffers agonies of indecision, inventing elaborate reasons for and against taking any course which lies before him. But once in action he finds it hard to stop. An obsessive is characteristically the sort of person who goes over his work again and again and yet is never sure that it is done right. Finally, the obsessive may complain of nervousness, tenseness, a pervasive anxiety having no definite object. His is the "nervous temperament."

The work of the psychopathologists, and particularly that of Freud, has shown that obsession may be the end product of a faulty education, the word education being used in its broadest sense to mean the training which an individual receives from earliest childhood and which has the purpose of making him able, as an adult, to take an effective part in society. It may appear also, though in a less extreme degree, in anyone who is in every other sense a normal human being if he cannot respond adequately to the situation in which he finds himself. He will be besieged by the same distorted thoughts about himself and other people. He will suffer from the same inability to act easily and appropriately. He will be aware of the same vague anxiety. A simple example is a person who is, as we say, "overtired." Everyone has had experience with such persons—or has been overtired himself—and knows that for the moment their behavior is quite abnormal.

In short, obsessive behavior may appear in many degrees and under many different conditions. This was the fact which struck the investigators at Hawthorne. Very few of the employees interviewed showed themselves to be candidates for a mental hospital, but the interview records suggested that many of them were elaborating their thinking in a typically obsessive manner. In some instances, the obsessive response could be traced to the home situa-

tion of the employee, particularly likely to be disorganized in a large and rapidly growing city, full of unassimilated immigrant groups. But in some cases it could apparently be traced only to the work situation at the plant. Something in their experience of industrial life produced in a number of employees a conviction of personal inadequacy. Nor was this response limited to the rank and file. Members of the top management at Hawthorne were not interviewed, but there is no reason to believe that management is exempt from obsessive thinking or even obsessive actions.

These conclusions were very general and seemed to be rather questions for further investigation than statements of observed fact. Nevertheless the experience of the interviewers did have one immediate result: a change in the method of interviewing. In order that the flow of the narrative may not be interrupted, the final form of the method as it was developed at Hawthorne will be described in a separate part of this report, but a word or two about it will not be out of place here. The report of 1931 described it as follows: "The interviewer is introduced to the employee, and the interviewer 'catches on' in a conversational way at any starting point mentioned by the employee. As long as an employee talks the interviewer follows his comments, displaying a real interest in what the employee has to say and taking sufficient notes to recall the employee's various comments. While the employee continues, no attempt is made on the part of the interviewer to change the subject, because it is a basic assumption of the method that, where the employee chooses his own topics, he chooses them largely in their order of importance for him. If the interviewer were to ask questions or to redirect the employee's comment to other topics or subjects he would in a sense ask the employee to talk about a subject important perhaps to the interviewer, but not necessarily at all important to the employee. The interviewer takes part in the conversation only in so far as it is necessary to keep the employee talking and to stimulate confidence."

This is a description of the interviewing method as used by an interviewer assigned temporarily to the Industrial Research Division from a line organization. The permanent staff interviewers would carry the technique one step further. "They would listen very carefully for indications of stress and strain in the expressed thought of the individual. They would identify this unusual or exaggerated feeling on the part of the employee by such symptoms as expressions made with unusual emotion, exaggeration, or reiteration. These more skilled interviewers would then, carefully perhaps, press these topics further by questions and suggestions after

the employee seemed to be otherwise 'talked out.' By this subsequent probing of these 'spots' in the attitude and feeling of employees, new levels of meaning and interpretation are discovered both for the interviewer and the employee." Clearly the set of questions with which the early investigators had gone to their interviews had wholly disappeared, and instead of regarding the personal preoccupations of the employees as in a sense irrelevant, the investigators were carefully following them up as a source of important understanding of the person interviewed and the human situation in the plant.

It is obvious that the Western Electric researches were all interrelated. One led to another. In planning each experiment, the investigators had in their minds hypotheses which they wished to test; but more important than any hypothesis was the simple desire to find out more about the employees. The factors which led to the next development of the research program were complicated and certainly were not fully realized at the time by the investigating group. The program had begun with a simple attempt to discover by experimentation the effect of changes in physical conditions on efficiency of work. The technique used was a standard one: other factors were to be held constant in order to isolate the effect on the output rate of changes in working conditions. The Relay Assembly Test Room showed that this method would not yield the expected results. In the very process of setting up the experiment, one of the important factors affecting output was being varied rather than held constant. But full realization of this fact did not come until later. The point which emerged at once from the Relay Assembly Test Room was that management really knew very little about the employees' reaction to physical conditions of work and methods of supervision. The Interviewing Program was undertaken with the object of finding out more about these matters, but once more the expectations of the investigators were not realized. The comments elicited from the employees in the interviews were of only limited use in improving working conditions and methods of supervision, and attempts to analyze the material statistically in terms of likes and dislikes came to no significant conclusions.

On the other hand, the comments did acquire meaning if they were taken in their context, as symptoms of sentiments, beliefs, unconscious assumptions held by the persons interviewed; and for a time the investigators were much interested in studying the employees as individuals, each with a personal history which, properly understood, explained much of his behavior. Members of the Department of Industrial Research in the Graduate School of

Business Administration, Harvard University, had advised the company in the researches and had followed them closely. The next suggestion came from W. L. Warner, at that time Assistant Professor of Anthropology in Harvard University. It was that the comments secured in the interviews could not be treated as products of individual human beings. They were the precipitate of interaction between people in organized social groups: families, neighborhoods, working groups, and so forth. The investigators were naturally most interested in the social organization of the employees at the Hawthorne Works; and as a result of this new understanding, they gradually lost interest in individual interviews, just as they had lost interest in the Relay Assembly Test Room. They took another step away from their original point of departure and turned to what they were fond of calling the "actual working situation." They were beginning to study the social relations between people actually at work on the job.

Furthermore, the investigators were turned in this direction by certain practical problems which had arisen in the course of the Interviewing Program. The interviewers were receiving a more thorough training. The plan of interviewing all employees once a year had been adopted, but the interviews had grown longer and therefore more expensive. And there were employees who needed interviewing more often than once a year. A good picture of their situation could not be secured at a single interview, yet continuous interviewing could not be applied as a regular program all over the plant. There seemed to be a need both to limit and to concentrate the effort of interviewing.

Finally, the investigators discovered, in the course of the regular interviews, evidence here and there in the plant of a type of behavior which strongly suggested that the workers were banding together informally in order to protect themselves against practices which they interpreted as a menace to their welfare. This type of behavior manifested itself in (*a*) "straight-line" output, that is, the operators had adopted a standard of what they felt to be a proper day's work and none of them exceeded it by very much; (*b*) a resentment of the wage incentive system under which they worked—in most cases, some form of group piecework; (*c*) expressions which implied that group piecework as a wage incentive plan was not working satisfactorily; (*d*) informal practices by which persons who exceeded the accepted standard, that is, "rate killers," could be punished and "brought into line"; (*e*) informal leadership on the part of individuals who undertook to keep the working group together and enforce its rules; (*f*) preoccupations of futility with regard to pro-

motion; and (g) extreme likes and dislikes toward immediate superiors, according to their attitude toward the behavior of the operators. The investigators felt that this complex of behavior deserved further study.

In view of these considerations, the decision was taken in May, 1931, to assign selected interviewers to particular groups of employees and allow them to interview the employees as often as they felt was necessary. The story of one of these groups is characteristic of the findings reached by this new form of interviewing. The work of the employees was the adjustment of small parts which went into the construction of telephone equipment. The management thought that the adjustment was a complicated piece of work. The interviewer found that it was really quite simple. He felt that anyone could learn it, but that the operators had conspired to put a fence around the job. They took pride in telling how apparatus which no one could make work properly was sent in from the field for adjustment. Then telephone engineers would come in to find out from the operators how the repairs were made. The latter would fool around, doing all sorts of wrong things and taking about two hours to adjust the apparatus, and in this way prevented people on the outside from finding out what they really did. They delighted in telling the interviewer how they were pulling the wool over everybody's eyes. It followed that they were keeping the management in ignorance as to the amount of work they could do. The output of the group, when plotted, was practically a straight line.

Obviously this result could not have been gained without some informal organization, and such organization in fact there was. The group had developed leadership. Whenever an outsider—engineer, inspector, or supervisor—came into the room, one man always dealt with him. Whenever any technical question was raised about the work, this employee answered it. For other purposes, the group had developed a second leader. Whenever a new man came into the group, or a member of the group boosted output beyond what was considered the proper level, this second leader took charge of the situation. The group had, so to speak, one leader for dealing with foreign and one for dealing with domestic affairs. The different supervisors were largely aware of the situation which had developed, but they did not try to do anything about it because in fact they were powerless. Whenever necessary, they themselves dealt with the recognized leaders of the group.

Finally, the investigator found that the group was by no means happy about what it was doing. Its members felt a vague dissatis-

faction or unrest, which showed itself in a demand for advancements and transfers or in complaints about their hard luck in being kept on the job. This experience of personal futility could be explained as the result of divided loyalties—divided between the group and the company.

In order to study this kind of problem further, to make a more detailed investigation of social relations in a working group, and to supplement interview material with direct observation of the behavior of employees, the Division of Industrial Research decided to set up a new test room. But the investigators remembered what happened in the former test room and tried to devise an experiment which would not be radically altered by the process of experimentation itself. They chose a group of men—nine wiremen, three soldermen, and two inspectors—engaged in the assembly of terminal banks for use in telephone exchanges, took them out of their regular department and placed them in a special room. Otherwise no change was made in their conditions of work, except that an investigator was installed in the room, whose duty was simply to observe the behavior of the men. In the Relay Assembly Test Room a log had been kept of the principal events of the test. At the beginning it consisted largely of comments made by the workers in answer to questions about their physical condition. Later it came to include a much wider range of entries, which were found to be extremely useful in interpreting the changes in the output rate of the different workers. The work of the observer in the new test room was in effect an expansion of the work of keeping the log in the old one. Finally, an interviewer was assigned to the test room; he was not, however, one of the population of the room but remained outside and interviewed the employees from time to time in the usual manner. No effort was made to get output records other than the ones ordinarily kept in the department from which the group came, since the investigators felt that such a procedure would introduce too large a change from a regular shop situation. In this way the experiment was set up which is referred to as the Bank Wiring Observation Room. It was in existence seven months, from November, 1931, to May, 1932.

The method of payment is the first aspect of this group which must be described. It was a complicated form of group piecework. The department of which the workers in the observation room were a part was credited with a fixed sum for every unit of equipment it assembled. The amount thus earned on paper by the department every week made up the sum out of which the wages of all the men in the department were paid. Each individual was then assigned an

hourly rate of pay, and he was guaranteed this amount in case he did not make at least as much on a piecework basis. The rate was based on a number of factors, including the nature of the job a worker was doing, his efficiency, and his length of service with the company. Records of the output of every worker were kept, and every six months there was a rate revision, the purpose of which was to make the hourly rates of the different workers correspond to their relative efficiency.

The hourly rate of a given employee, multiplied by the number of hours worked by him during the week, was spoken of as the daywork value of the work done by the employee. The daywork values of the work done by all the employees in the department were then added together, and the total thus obtained was subtracted from the total earnings credited to the department for the number of units of equipment assembled. The surplus, divided by the total daywork value, was expressed as a percentage. Each individual's hourly rate was then increased by this percentage, and the resulting hourly earnings figure, multiplied by the number of hours worked, constituted that person's weekly earnings.

Another feature of the system should be mentioned here. Sometimes a stoppage which was beyond the control of the workers took place in the work. For such stoppages the workers were entitled to claim time out, being paid at their regular hourly rates for this time. This was called the "daywork allowance claim." The reason why the employees were paid their hourly rate for such time and not their average hourly wages was a simple one. The system was supposed to prevent stalling. The employees could earn more by working than they could by taking time out. As a matter of fact, there was no good definition of what constituted a stoppage which was beyond the control of the workers. All stoppages were more or less within their control. But this circumstance was supposed to make no difference in the working of the system, since the assumption was that in any case the workers, pursuing their economic interests, would be anxious to keep stoppages at a minimum.

This system of payment was a complicated one, but it is obvious that there was a good logical reason for every one of its features. An individual's earnings would be affected by changes in his rate or in his output and by changes in the output of the group as a whole. The only way in which the group as a whole could increase its earnings was by increasing its total output. It is obvious also that the experts who designed the system made certain implicit assumptions about the behavior of human beings, or at least the behavior of workers in a large American factory. They assumed

that every employee would pursue his economic interest by trying to increase not only his own output but the output of every other person in the group. The group as a whole would act to prevent slacking by any of its members. One possibility, for instance, was that by a few weeks' hard work an employee could establish a high rate for himself. Then he could slack up and be paid out of all proportion with the amount he actually contributed to the wages of the group. Under these circumstances, the other employees were expected to bring pressure to bear to make him work harder.

Such was the way in which the wage incentive scheme ought to have worked. The next question is how it actually did work. At first the workers were naturally suspicious of the observer, but when they got used to him and found that nothing out of the ordinary happened as a result of his presence in the room, they came to take him for granted. The best evidence that the employees were not distrustful of the observer is that they were willing to talk freely to him about what they were doing, even when what they were doing was not strictly in accord with what the company expected. Conversation would die down when the group chief entered the room, and when the foreman or the assistant foreman entered everyone became serious. But no embarrassment was felt at the presence of the observer. To avoid misunderstanding, it is important to point out that the observer was in no sense a spy. The employees were deliberately and obviously separated from their regular department. The observer did not, and could not, pass himself off as one of them. And if only from the fact that a special interviewer was assigned to them, the members of the group knew they were under investigation.

The findings reached by the observer were more detailed but in general character the same as those which had emerged from the early interviews of other groups. Among the employees in the observation room there was a notion of a proper day's work. They felt that if they had wired two equipments a day they had done about the right amount. Most of the work was done in the morning. As soon as the employees felt sure of being able to finish what they considered enough for the day, they slacked off. This slacking off was naturally more marked among the faster than among the slower workmen.

As a result, the output graph from week to week tended to be a straight line. The employees resorted to two further practices in order to make sure that it should remain so. They reported more or less output than they performed and they claimed more daywork allowances than they were entitled to. At the end of the day, the

observer would make an actual count of the number of connections wired—something which was not done by the supervisors—and he found that the men would report to the group chief sometimes more and sometimes less work than they actually had accomplished. At the end of the period of observation, two men had completed more than they ever had reported, but on the whole the error was in the opposite direction. The theory of the employees was that excess work produced on one day should be saved and applied to a deficiency on another day. The other way of keeping the output steady was to claim excessive daywork allowance. The employees saw that the more daywork they were allowed, the less output they would have to maintain in order to keep the average hourly output rate steady. The claims for daywork allowance were reported by the men to their group chief, and he, as will be seen, was in no position to make any check. These practices had two results. In the first place, the departmental efficiency records did not represent true efficiency, and therefore decisions as to grading were subject to errors of considerable importance. In the second place, the group chief was placed in a distinctly awkward position.

The findings of the observer were confirmed by tests which were made as a part of the investigation. Tests of intelligence, finger dexterity, and other skills were given to the workers in the room, and the results of the tests were studied in order to discover whether there was any correlation between output on the one hand and earnings, intelligence, or finger dexterity on the other. The studies showed that there was not. The output was apparently not reflecting the native intelligence or dexterity of the members of the group.

Obviously the wage incentive scheme was not working in the way it was expected to work. The next question is why it was not working. In this connection, the observer reported that the group had developed an informal social organization, such as had been revealed by earlier investigations. The foreman who selected the employees taking part in the Bank Wiring Observation Room was co-operative and had worked with the investigators before. They asked him to produce a normal group. The men he chose all came out of the same regular shop department, but they had not been closely associated in their work there. Nevertheless, as soon as they were thrown together in the observation room, friendships sprang up and soon two well-defined cliques were formed. The division into cliques showed itself in a number of ways: in mutual exclusiveness, in differences in the games played during off-hours, and so forth.

What is important here is not what divided the men in the observation room but what they had in common. They shared a common body of sentiments. A person should not turn out too much work. If he did, he was a "rate-buster." The theory was that if an excessive amount of work was turned out, the management would lower the piecework rate so that the employees would be in the position of doing more work for approximately the same pay. On the other hand, a person should not turn out too little work. If he did, he was a "chiseler"; that is, he was getting paid for work he did not do. A person should say nothing which would injure a fellow member of the group. If he did, he was a "squealer." Finally, no member of the group should act officiously.

The working group had also developed methods of enforcing respect for its attitudes. The experts who devised the wage incentive scheme assumed that the group would bring pressure to bear upon the slower workers to make them work faster and so increase the earnings of the group. In point of fact, something like the opposite occurred. The employees brought pressure to bear not upon the slower workers but upon the faster ones, the very ones who contributed most to the earnings of the group. The pressure was brought to bear in various ways. One of them was "binging." If one of the employees did something which was not considered quite proper, one of his fellow workers had the right to "bing" him. Binging consisted of hitting him a stiff blow on the upper arm. The person who was struck usually took the blow without protest and did not strike back. Obviously the virtue of binging as punishment did not lie in the physical hurt given to the worker but in the mental hurt that came from knowing that the group disapproved of what he had done. Other practices which naturally served the same end were sarcasm and the use of invectives. If a person turned out too much work, he was called names, such as "Speed King" or "The Slave."

It is worth while pointing out that the output of the group was not considered low. If it had been, some action might have been taken, but in point of fact it was perfectly satisfactory to the management. It was simply not so high as it would have been if fatigue and skill had been the only limiting factors.

In the matter of wage incentives, the actual situation was quite different from the assumptions made by the experts. Other activities were out of line in the same way. The wiremen and the soldermen did not stick to their jobs; they frequently traded them. This was forbidden, on the theory that each employee ought to do his own work because he was more skilled in that work. There was

also much informal helping of one man by others. In fact, the observation of this practice was one means of determining the cliques into which the group was divided. A great many things, in short, were going on in the observation room which ought not to have been going on. For this reason it was important that no one should "squeal" on the men.

A group chief was in immediate charge of the employees. He had to see that they were supplied with parts and that they conformed to the rules and standards of the work. He could reprimand them for misbehavior or poor performance. He transmitted orders to the men and brought their requests before the proper authorities. He was also responsible for reporting to the foreman all facts which ought to come to his attention. The behavior of the employees put him in an awkward position. He was perfectly well aware of the devices by which they maintained their production at a constant level. But he was able to do very little to bring about a change. For instance, there was the matter of claims for daywork allowance. Such claims were supposed to be based on stoppages beyond the control of the workers, but there was no good definition of what constituted such stoppages. The men had a number of possible excuses for claiming daywork allowance: defective materials, poor and slow work on the part of other employees, and so forth. If the group chief checked up on one type of claim, the workers could shift to another. In order to decide whether or not a particular claim was justified, he would have to stand over the group all day with a stop watch. He did not have time to do that, and in any case refusal to honor the employees' claims would imply doubt of their integrity and would arouse their hostility. The group chief was a representative of management and was supposed to look after its interests. He ought to have put a stop to these practices and reported them to the foreman. But if he did so, he would, to use the words of a short account of the observation room by Roethlisberger and Dickson, "lose sympathetic control of his men, and his duties as supervisor would become much more difficult." [1] He had to associate with the employees from day to day and from hour to hour. His task would become impossible if he had to fight a running fight with them. Placed in this situation, he chose to side with the men and report unchanged their claims for daywork. In fact there was very

[1] F. J. Roethlisberger and W. J. Dickson, "Management and the Worker," Harvard Business School: Division of Research, Business Research Studies, No. 9 (a monograph). (All quotations relating to the Western Electric researches are from this study as well as from the book of the same title by the same authors.)

little else he could do, even if he wished. Moreover he was in a position to protect himself in case of trouble. The employees always had to give him a reason for any daywork claims they might make, and he entered the claims in a private record book. If anyone ever asked why so much daywork was being claimed, he could throw the blame wherever he wished. He could assert that materials had been defective or he could blame the inspectors, who were members of an outside organization. In still another respect, then, the Bank Wiring Observation Room group was not behaving as the logic of management assumed that it would behave.

Restriction of output is a common phenomenon of industrial plants. It is usually explained as a highly logical reaction of the workers. They have increased their output, whereupon their wage rates for piecework have been reduced. They are doing more work for the same pay. They restrict their output in order to avoid a repetition of this experience. Perhaps this explanation holds good in some cases, but the findings of the Bank Wiring Observation Room suggest that it is too simple. The workers in the room were obsessed with the idea that they ought to hold their production level "even" from week to week, but they were vague as to what would happen if they did not. They said that "someone" would "get them." If they turned out an unusually high output one week, that record would be taken thereafter as an example of what they could do if they tried, and they would be "bawled out" if they did not keep up to it. As a matter of fact, none of the men in the room had ever experienced a reduction of wage rates. What is more, as Roethlisberger and Dickson point out, "changes in piece rates occur most frequently where there is a change in manufacturing process, and changes in manufacturing process are made by engineers whose chief function is to reduce unit cost wherever the saving will justify the change. In some instances, changes occur irrespective of direct labor cost. Moreover, where labor is a substantial element, reduction of output tends to increase unit costs and instead of warding off a change in the piece rate may actually induce one."

What happened in the observation room could not be described as a logical reaction of the employees to the experience of rate reduction. They had in fact had no such experience. On the other hand, the investigators found that it could be described as a conflict between the technical organization of the plant and its social organization. By technical organization the investigators meant the plan, written or unwritten, according to which the Hawthorne plant was supposed to operate, and the agencies which gave effect to that plan. The plan included explicit rules as to how the men were to be paid,

how they were to do their work, what their relations with their supervisors ought to be. It included also implicit assumptions on which the rules were based, one of the assumptions being that men working in the plant would on the whole act so as to further their economic interests. It is worth while pointing out that this assumption was in fact implicit, that the experts who devised the technical organization acted upon the assumption without ever stating it in so many words.

There existed also an actual social situation within the plant: groups of men, who were associated with one another, held common sentiments and had certain relations with other groups and other men. To some extent this social organization was identical with the technical plan and to some extent it was not. For instance, the employees were paid according to group payment plans, but the groups concerned did not behave as the planners expected them to behave.

The investigators considered the relations between the technical organization and the social. A certain type of behavior is expected of the higher levels of management. Their success is dependent on their being able to devise and institute rapid changes. Roethlisberger and Dickson describe what happens in the following terms: "Management is constantly making mechanical improvements and instituting changes designed to reduce costs or improve the quality of the product. It is constantly seeking new ways and new combinations for increasing efficiency, whether in designing a new machine, instituting a new method of control, or logically organizing itself in a new way." The assumption has often been made that these changes are designed to force the employee to do more work for less money. As a matter of fact, many of them have just the opposite purpose: to improve the conditions of work and enable the employee to earn higher wages. The important point here, however, is not the purpose of the changes but the way in which they are carried out and accepted.

Once the responsible officer has decided that a certain change ought to be made, he gives an order, and this order is transmitted "down the line," appropriate action being taken at every level. The question in which the investigators were interested was this: What happens when the order reaches the men who are actually doing the manual work? Roethlisberger and Dickson make the following observations: "The worker occupies a unique position in the social organization. He is at the bottom of a highly stratified organization. He is always in the position of having to accommodate himself to changes which he does not originate. Although he par-

ticipates least in the technical organization, he bears the brunt of most of its activities." It is he, more than anyone, who is affected by the decisions of management, yet in the nature of things he is unable to share management's preoccupations, and management does little to convince him that what he considers important is being treated as important at the top—a fact which is not surprising, since there is no adequate way of transmitting to management an understanding of the considerations which seem important at the work level. There is something like a failure of communication in both directions—upward and downward.

The worker is not only "asked to accommodate himself to changes which he does not initiate, but also many of the changes deprive him of those very things which give meaning and significance to his work." The modern industrial worker is not the handicraftsman of the medieval guild. Nevertheless, the two have much in common. The industrial worker develops his own ways of doing his job, his own traditions of skill, his own satisfactions in living up to his standards. The spirit in which he adopts his own innovations is quite different from that in which he adopts those of management. Furthermore, he does not do his work as an isolated human being, but always as a member of a group, united either through actual co-operation on the job or through association in friendship. One of the most important general findings of the Western Electric researches is the fact that such groups are continually being formed among industrial workers, and that the groups develop codes and loyalties which govern the relations of the members to one another. Though these codes can be quickly destroyed, they are not formed in a moment. They are the product of continued, routine interaction between men. "Constant interference with such codes is bound to lead to feelings of frustration, to an irrational exasperation with technical change in any form, and ultimately to the formation of a type of employee organization such as we have described—a system of practices and beliefs in opposition to the technical organization."

The Bank Wiring Observation Room seemed to show that action taken in accordance with the technical organization tended to break up, through continual change, the routines and human associations which gave work its value. The behavior of the employees could be described as an effort to protect themselves against such changes, to give management the least possible opportunity of interfering with them. When they said that if they increased their output, "something" was likely to happen, a process of this sort was going on in their minds. But the process was not a conscious one. It is important

to point out that the protective function of informal organization was not a product of deliberate planning. It was more in the nature of an automatic response. The curious thing is that, as Professor Mayo pointed out to the Committee, these informal organizations much resembled formally organized labor unions, although the employees would not have recognized the fact.

Roethlisberger and Dickson summarize as follows the results of the intensive study of small groups of employees: "According to our analysis the uniformity of behavior manifested by these groups was the outcome of a disparity in the rates of change possible in the technical organization, on the one hand, and in the social organization, on the other. The social sentiments and customs of work of the employees were unable to accommodate themselves to the rapid technical innovations introduced. The result was to incite a blind resistance to all innovations and to provoke the formation of a social organization at a lower level in opposition to the technical organization."

It is curious how, at all points, the Relay Assembly Test Room and the Bank Wiring Observation Room form a contrast. In the former, the girls said that they felt free from the pressure of supervision, although as a matter of fact they were far more thoroughly supervised than they ever had been in their regular department. In the latter, the men were afraid of supervision and acted so as to nullify it. The Bank Wiremen were in the position of having to respond to technical changes which they did not originate. The Relay Assemblers had periodic conferences with the superintendent. They were told what experimental changes were contemplated; their views were canvassed, and in some instances they were allowed to veto what had been proposed. They were part of an experiment which they felt was interesting and important. Both groups developed an informal social organization, but while the Bank Wiremen were organized in opposition to management, the Relay Assemblers were organized in co-operation with management in the pursuit of a common purpose. Finally, the responses of the two groups to their industrial situation were, on the one hand, restriction of output and, on the other, steady and welcome increase of output. These contrasts carry their own lesson.

During the depression, the Western Electric Company was forced to cut down many of its activities, and in the year 1932 its research in industrial relations was brought to an end. But the men who had been engaged in the work kept their interest in it, and

the return of good times led to an opportunity for further development. The new departure is called "personnel counseling" and is essentially an attempt to give practical application to the understandings which were reached in the course of the research program. An intracompany report describes the origin of the plan. "Early in January, 1936, at a conference at which the subject of industrial relations was being discussed, the following question was asked of the industrial relations people who were present: 'If you were to devise a personnel program which would take into account all of the factors which your research in this area shows to be significant, what sort of plan would you recommend?' The answer to this question was the personnel counseling experiment. In framing this experiment . . . there were two separate questions which had to be answered. The first concerned the objectives to be achieved. The second question was that of devising a plan for achieving these objectives."

One of the objectives to be achieved concerned the effectiveness of the individual employee. The research program had shown that effectiveness depended on a large number of factors. It depended on the physical conditions of work, although on investigation this factor appeared to be less important than had been supposed. It depended also on the unique social experience of the employee, both his past history and his present social relations within the factory and without. More and more, this factor appeared to be the decisive one, but all factors were involved. The investigators liked to say that efficiency was a function of the employee's "total situation."

The question was how to deal with low efficiency in the light of this new understanding. All employees were supposed to conform to more or less uniform standards of output, quality of work, and general conduct. There were always a certain number who did not, and these persons became problems to their supervisors. The usual way of dealing with them was the application of pressures of a rather obvious sort; but with many individuals this method failed because it was directed at their conscious understanding, whereas the source of their inefficiency lay far beneath conscious control. The Interviewing Program had shown that the proper way to proceed was to explore the individual's personal situation, discover the source of the difficulty, and then try to act on the diagnosis. Sometimes interviewing alone, the mere opportunity to give full expression to worries and other tensions, led to an improved attitude toward work. The tensions disappeared at the point of expression. Unfortunately, this process commonly took time, and even if they were properly qualified for the work, most supervisors did not have

time to spare. Another limitation inhered in the social relationship of the supervisor and the employee. This relationship was necessarily authoritative, and it made the employee reluctant to discuss his situation sufficiently frankly with his supervisor for a thorough appraisal of it to be made. In short, experience showed the need for an agency which would be concerned only with interviewing and which would have no authority over the employees interviewed. To quote once more from the company report: "There is a very real need for an impartial, non-authoritative agency whose function is that of interviewing employees, diagnosing their problems, and where necessary counseling with the supervisor regarding his methods of supervising these people. In planning the personnel counseling experiment, this was regarded as one of the important objectives to be achieved."

The second objective related broadly to communication. The Interviewing Program, supplemented by the studies which culminated in the Bank Wiring Observation Room, had shown that the picture of the work situation which was held and acted upon by the upper levels of management was in many respects quite unlike the reality. The methods of payment and supervision were not working as they would have worked if the assumptions of management had been correct. The employees had many strong sentiments in regard to such things as seniority, age, sex, workmanship, nationality, social responsibility, occupation, and position in the group. Many of the objects of the physical environment were symbolic of the status the individual had achieved. For instance, a certain sort of desk became associated with a certain position in the hierarchy of supervision, and a supervisor of that grade would feel uncomfortable if he did not have a desk of the appropriate type. The behavior of the employees was influenced by these factors even more than by sheer monetary incentive, although in the logic of management money was assumed to be the leading motive.

The employees had elaborate informal organizations within the scheme of formal relations established by the company. In the words of the company report: "The function of these informal organizations seemed to be twofold. The first was that of providing the work group with a certain feeling of security. It appeared as though the employees were rather unconsciously attempting to protect themselves from real or fancied consequences of supervisory practices and technical innovations. Group restriction of output was one of the chief protective devices thus elaborated. The second function of these informal organizations appeared to be that of providing the work group with those intangible social satisfactions

which come from being an integral member of a closely knit group. Various kinds of leadership were also provided for by these informal groupings which were not defined in the formal organization of their work situation." Mr. H. A. Wright of the Western Electric Company testified that this discovery was the principal one made in the course of the research program.

The research program had produced a detailed picture of the sentiments of workers and their informal social organization. On the other hand, management often had to act in ignorance of these facts. This statement does not mean that many men in the hierarchy of supervision—the sort of men who could do their jobs by ear—were not intuitively aware of the realities of the situation. They were well aware and shaped their behavior accordingly. In this sense, the discoveries of the investigators were not discoveries at all. But such knowledge was not being transmitted. It remained essentially private property. "The supervisory structure was not functioning to communicate facts of this kind upward partly because the importance of the material was not understood, partly because the lower level supervisors were of necessity so much a part of the work situation that they could not study it objectively and, in part, because material of this sort is difficult to transmit in a useful form. As a consequence, management practices and procedures frequently collided with the sentiments of the employees, with the result that the employees formed an informal protective organization against such practices. Stated in another way, it appeared as though management, using the term in its broadest sense, habitually acted as though the technical, economic organization of the company was something apart from its social organization, and that the one did not appreciably affect the other. These studies showed that the social organization is intimately related to the technical organization and that changes in one affect the other. They further suggested that the problem of collaboration and work effectiveness is essentially a problem of how these two aspects of the total company structure are related and kept in balance.

"The problem here, therefore, appeared to be that of communicating a more accurate picture of the situation at the work level to management. In order to do this, however, it seemed that here again an outside agency skilled in the techniques of interviewing and observation and familiar with the methods of individual and group analysis could function best. This therefore was stated as the second broad objective of the personnel counseling experiment.

"To summarize, it was felt that in devising a more adequate plan

for doing personnel work the following objectives should be kept in mind:

"1. To study and obtain correction of problems pertaining to the individual.
  1.1 Where the problem is psychological, to attempt to secure an adjustment by skilled interviewing.
  1.2 Where the problem arises from a defective relationship between supervisor and employee, to counsel the supervisor indirectly regarding his supervisory methods.
"2. To study and obtain correction of problems pertaining to the work group.
  2.1 To study the effect of management policies and practices at the work level.
  2.2 To communicate general observations, material which does not reflect upon any identifiable person, to management.
"3. To conduct intensive studies of problems unearthed by the personnel counseling activity which seem worthy of research and development."

The next problem was that of devising a concrete plan, and the one finally adopted was the following. A trained interviewer from the Industrial Relations Branch was to be assigned to one or two subdepartments, according to the number of employees concerned. This person, who was to be called a personnel counselor, would spend his whole time interviewing the employees in his territory. He would also familiarize himself with the different kinds of work and make himself acquainted with supervisors of different levels in the hope that they would feel free to discuss their problems with him. He would conduct his interviews in privacy and away from the employee's place of work, and he would guarantee, as in the earlier Interviewing Program, that nothing would be reported elsewhere which would in any way identify the employee. The employee would be paid his average hourly wage for the time spent in the interview. Finally, the personnel counselor would strictly avoid taking sides in any controversial issue and refrain from assuming a position of authority in his dealings with employees and supervisors. He was to act as a strictly independent agent.

This plan was discussed at a meeting of the Hawthorne management in January, 1936, and a decision was reached to try it out as an experiment in the Panel Apparatus Department of the Central Office Division. Considerable thought was given to the problem of

introducing the plan to the supervisors and employees. Its success depended to a large extent on the way they received it. The method actually used was the following. When the Division Chief had given his consent to the introduction of the experiment in his division, he undertook to explain the program to all of his supervisors at one of their regular monthly meetings. The points he emphasized particularly in this talk were: (1) that the counselor would not assume any of the duties or responsibilities delegated to them; (2) that it was hoped that they would feel free to discuss their problems with him; and (3) that the counselor would be extremely careful not to divulge information of a personal nature, obtained through his contacts with them and their employees, which might embarrass them in any way.

The supervisors of higher rank were told that the group chiefs subordinate to them would be expected to introduce the plan to the employees. In doing so, they were not to give it too much emphasis. They were to say that the company was trying a new way of doing personnel work and that a "personnel man" had been assigned to the department who might be around soon to talk to them individually. They were to say that the employees would be paid their average earnings for time spent in talking to the counselor. Further explanation of the plan was left to the counselor himself in his interviews. By this time the employees were quite familiar, either by personal experience or by hearsay, with the company's investigations in industrial relations, and apparently had full confidence in its motives.

As a matter of fact, no difficulties were encountered in introducing the experiment, and the early progress reports were favorable. It may be well to quote from the first of them, dated April 8, 1936: "The supervisors seem actively interested in the plan and, in several instances, they have said that they would welcome the assistance that the 'personnel man' might offer in helping them to gain a more complete understanding of their human problems and in getting their thoughts and their problems up the line. With regard to the employees, it is sufficient to say that they are all as interested in the plan as they were in the Interviewing Program. They go out of their way to speak to the 'personnel man' whenever he is in their section. They talk openly and freely of their problems and this in itself appears to be beneficial to them." The program was gradually extended to other departments and the number of counselors increased. At the time when the program was described to the Committee (March 9, 1938), there were fifteen counselors, at

different stages of training and effectiveness, but all actually at work in shop departments.

In the Interviewing Program, the Division of Industrial Research had maintained a nucleus staff of trained investigators and had used as its other interviewers men taken for temporary periods from among the regular supervisory personnel. When the Personnel Counseling Program was introduced, this method was given up. From outside the Hawthorne plant young men and women recently graduated from school or college were specially recruited for the work. After a certain amount of preliminary instruction given by members of the permanent staff of the Industrial Relations Branch, they were set to work in shop departments. Their work was carefully supervised by the permanent staff and was the subject of numerous conferences in which counselors and staff members took part. The men in charge of the work felt that the interest and enthusiasm of the new group were fully up to that developed in the earlier research program, and that the method of training, while brief, did turn out counselors who were entirely adequate for their duties. This point is an important one, for the further extension of work in this field of research depends largely on the development of a proper method of training. Experience in other fields, for instance that of medicine, suggests that one of the best ways of developing in a young man an interest in and understanding of intellectual problems is to allow him, under proper guidance, to take actual responsibility in dealing with these problems.

Perhaps it is still too early to assess the value of personnel counseling, but some of the comments, favorable and unfavorable, which have been made upon the plan may well be of interest. The objections may be taken first. Where there were unsatisfactory relations between a supervisor and the employees under him, a few employees asked whether the interviews were really to be confidential. In these cases, renewed assurances were given that the interviews would be kept secret to the extent that the name of an employee could not possibly be associated with any reports made to higher authorities. These promises have been respected. Some supervisors have raised similar questions about the use made of the material obtained and the value of interviewing employees who they felt were contented. In all such cases the fears of the persons concerned were overcome, and they were assured that the plan offered in the long run a method of increasing employee satisfaction.

Before the passage of the Wagner Act, the workers at the Hawthorne plant were represented by a company union. After the passage of the act an independent union was formed. When personnel

counseling was introduced, the heads of the union raised questions concerning the relation between their work as employee representatives and the work of the counselors. They were assured that the counselors were trying to improve relations between the employee and his supervisor and help supervisors to understand employee problems. The function of the employee representatives was not to be duplicated in any way, and the counselors were to be careful not to undermine their position. The representatives were satisfied with this explanation, and no friction has arisen between them and management as a result of the activities of the counselors. Before the experiment was introduced, there was, as a matter of fact, a feeling among the officers of the company that, in discussing the affairs of the plant with the employee representatives, neither side talked about the problems which were really vital at the work level. Management felt that the findings of the counselors would be helpful in this respect.

The matter of the employee representatives brings up the question which is often asked by persons to whom the personnel counseling plan has been described: whether or not it is some form of "spy system." Such persons feel that it could be used as a means of gathering information which would justify open opposition to employee requests. The best answer to this question is that personnel counseling has not in fact been used in this manner, and the employees have not felt that it is a spy system. The essence of any system of espionage is its secrecy. There is no secret about personnel counseling.

In the matter of favorable comments, the men in charge felt that the experiment had led to improvements in three main fields: personal adjustments, supervisor-employee relations, and employee-management relations. We may consider them in this order. Cases which came under the first head ranged all the way from employees who felt normal drives for progress and advancement, and benefited by being able to talk over their personal affairs with an impartial listener, to neurotic individuals who needed considerable attention before their fundamental disorders could be cleared up. The latest company report on personnel counseling cited a particular case as evidence of the sort of work which was being done by the counselors.

One day an assistant foreman called the attention of the counselors to a problem which had been worrying him for some time. The problem was a man of forty-eight who had had about twenty years of service with the company. His history was as follows. In his early years of service he was apparently an efficient worker. He

was made a group chief in 1923 and remained in that position until 1931. But at that time he was considered one of the least efficient supervisors in the group, and thereafter his fall was gradual but steady. He was demoted from job to job, and in each successive job he failed to measure up to the proper standards of work. When the foreman consulted the counselors this employee was at work on a job of the lowest grade, being paid considerably more than this grade warranted, and not earning his money. These were the essentials of the problem as they appeared to the heads of the department when the foreman called in the counseling organization. "They felt that they had given the employee every possible opportunity to make good and that he had failed. They also were disturbed because he appeared to be drinking heavily and, more recently, because he was not at all co-operative."

The department proposed to shift the employee to a grade 1 (lowest grade) job in another organization and cut his hourly rate to the minimum of the grade. They proposed to explain to him that this would be his last chance and that if he failed he would be dismissed. In the meantime a counselor had been at work. He had had a preliminary interview with the employee which had indicated that the employee's failure was the result of a personal maladjustment. He asked that the transfer be delayed a few months or until a detailed study of the case could be made.

The study consisted of interviews with the employee, a thorough physical examination, several intelligence and vocational tests, and a careful investigation of the employee's supervisors, his associates on the job, and the mechanics of all the jobs on which he had failed. Here the report may be cited again: "The interview showed an employee who was raised in one of the west-side slum districts. The family consisted of two older sisters, an older brother, the employee, and a younger brother. The mother died when the employee was very young, and he does not remember her. The older sister managed the house. The father was a strict disciplinarian. The children were punished frequently and they were not allowed ordinary liberties. This was so pronounced that the older brother left home as soon as he finished school. The father was employed as a laborer until his death, which was shortly after the employee graduated from grammar school. The employee worked during vacation time while he was in seventh and eighth grades, and he found a steady job immediately after leaving school. He worked for several concerns until he enlisted in the army during the World War, and when he returned at the age of twenty-nine he was employed at Hawthorne.

"During this time he formed a close relationship with his older sister who never married. She kept house for him until a few years ago when he moved to a hotel across from the Plant. This move was made during the period when he was having difficulty on the job, but he continued to contribute toward her support and still has a very loyal attitude toward her."

Such was the past history of the employee, as it was revealed in his interviews with the personnel counselor. His attitudes in the immediate situation were described in the report as follows:

"1. Fear of the supervisors (foremen especially). Belief that they had it in for him. Feeling that they were watching him all the time. He could feel the foreman's eyes on him when the foreman was at the other end of the room.

"2. Belief that his nervousness was a 'shell shock' hangover from the war, in spite of the fact that he was in good health for years after the war and was not nervous until recently.

"3. Fear of sickness. He had been under the care of several doctors who tried to convince him that he was all right. He took 'nerve medicine' regularly four times a day. His closet shelf was full of pill boxes and cold cures. He wore a jacket on days when it was so hot that his shirt was wet with sweat. He talked of his health, his sister's health, boyhood friends who had terrible diseases. He went into a tantrum if the hotel room was cold or the department was draughty.

"4. His only associate outside the Plant was a tubercular war veteran with a shady character, and he did not see him often. Most of his time was spent in his room with a cheap magazine. He also did not talk to anyone in the department unless they asked him a question."

The method used in dealing with the employee was typical of personnel counseling. He was interviewed daily until he had expressed much of the emotional disturbance in his thinking and, in expressing it, freed himself from it. Thereafter the interviews were limited to two a week, and the counselor concentrated on helping him to think sensibly about his work, his supervisors, and his associates outside the plant. As soon as an improvement was recognizable, the counselor went to the proper group and section chiefs and asked them to talk about the employee. They were asked to express their criticism in as much detail as possible. The counselor did not differ with any of the opinions expressed except to make the general comment that he thought the employee's attitude had improved.

This process was carried so far that the counseling organization did not object when the division chief called with the information that the employee's hourly rate would have to be cut. This event occurred six months after the case had been opened. The organization asked only that the explanation be given to the employee in terms which would carry conviction to him. Later the organization attempted to assist the section chief in preparing a statement for the employee, and in this conversation the section chief found his case very weak and decided to do nothing.

The report continues as follows: "This approach to the problem has resulted in the following changes in the situation:

"1. The supervisors are taking a genuine interest in the employee and they are helping him with encouragement instead of criticism. Both the group and the section chiefs are now taking personal credit for the improvement and they claim to have made arrangements to assign him to higher graded work in the near future.

"2. The employee has increased his efficiency from between 60% and 70% to about 100%. There appears to be little lost motion in his activities on the job, and he appears to be getting a real feeling of satisfaction in doing his job better than the rest.

"He is also very friendly with all of the employees, both men and women, who work near him, and he spends his rest periods talking with a group of employees who work in the other end of the room.

"He has developed several close friends in the hotel and he occasionally joins a group playing pinochle. He has been keeping steady company with a girl whom he expects to marry. They plan to move to a furnished apartment. Due to her influence he spends several evenings a week at the movies and dances or with their friends.

"About a month ago he quit spending his money on doctors. He takes no medicine and says he feels better than he ever did. He has discarded the jacket that he was continually wearing and observes that he is no longer troubled with colds. This is interesting because he said he always had a cold about this time of year. The only remnant of the old attitude toward sickness is his excuse for marrying. He says a man of his age needs someone to take care of him.

"From a social point of view, this employee is now in working equilibrium with his environment. His attention is on the job. The supervisors appreciate his efforts; the new

> employees respect his knowledge of the job, and the older employees are friends instead of sympathizers. The concentration of our efforts on a personal adjustment without taking into account the other areas—supervisor, associates, and the job itself—would have probably resulted in failure. The total adjustment depended upon work with the employee's attitude, the supervisor's attitude, his associates' attitudes and with assistance in studying the job and developing an appreciation of co-ordination of activities."

The second field in which personnel counseling seemed to have had a good effect was that of the relations between employees and supervisors. The problems which might arise in this field ranged from supervisors whose habits mildly irritated the men under them, to supervisors who had removed themselves so far from the employees that they did not appreciate, and had no desire to try to appreciate, the more intimate employee reactions. In dealing with these problems, the counselor had to proceed with care. According to the rules under which he worked, he was bound to give no direct advice. All he could do was turn over to the supervisor in question those employees who had personal problems to discuss, and urge the supervisor to talk over these problems with the counselor as well. In this way, informally and indirectly, the counselor could bring about a change in the supervisor's attitude toward the problems of the employee.

One of the important questions which have been asked about personnel counseling is whether it takes away some of the authority of supervisors. Mr. H. A. Wright answered this question with the following argument. The history of industrial development has shown that whenever a particular skill, such as engineering, is developed as a special science, the method of bringing that science to bear on the actual work being done has always been to form a special organization and make it responsible for the appropriate part of the work. The new organization thus acquired authority to dictate to the operating or line organization, and the line supervisors lost part of their former function. In personnel work, the same tendency has in the past been evident, but it is avoided in personnel counseling. This plan is deliberately designed "to introduce new skills into the everyday work situation without assuming any authority or interfering with existing human relationships."

To illustrate how a personnel counselor ought to go to work, Professor Roethlisberger sketched a hypothetical case. Suppose a foreman in charge of a shop is acquainted with a particular situation

in which he wishes to take action. Suppose he wishes to transfer or promote an employee. He cannot do so without getting the backing of his superior, but this superior, the general foreman, is somewhat out of touch with the actual situation. He has no first-hand familiarity with the shop. The foreman is probably the sort of man who recognizes intuitively what factors are important and what action is necessary. Yet he has a hard time actually presenting his reasons to the general foreman in articulate form. Professor Roethlisberger made the comment that some such men become excited and exasperated simply because they cannot explain to higher authority the things that need to be done. How does the counselor act in this situation? It is important to remember in the first place that he is a trained specialist, trained in discovering, describing, and analyzing the problems which are involved in the interaction of human beings. In the second place, he has made it his business to talk over their difficulties with men at several levels of supervision. He is of course aware of the human situation in the shop. He first interviews the foreman and tries to get him to talk about the measures he wants his superior to consent to. In the course of this process the foreman probably comes to state his case more articulately and effectively. The counselor then interviews the superior, the general foreman. He says nothing about what happened in the first interview, but he gets the general foreman to talk about his problems, and perhaps comes around to the point that it is difficult for some persons to communicate to their superiors their reasons for action in a situation with which they are familiar. If the general foreman can be brought to understand this difficulty, he will soon be listening to his subordinates a little more carefully. Observe that the counselor takes no responsibility for action in the situation; he gives no advice; he does not even communicate all he knows. What he does is try to facilitate communication between the persons in fact responsible, so that whatever action is ultimately taken will be based on a full understanding.

Finally, the personnel counseling experiment has done much to improve management's understanding of employee sentiments. This statement does not mean that the counselors report in detail to higher management everything they learn. The counselor reports further "up the line" only those things which a supervisor allows him to report, and many of the problems revealed by the counselor's work are best solved by the person who has immediate responsibility and intimate acquaintance with the situation. There is obviously no need of taking every question to the higher officers of the company in Hawthorne and New York. But the counselors as a body are bound

to state their general findings about employee behavior and sentiments in such a way that management can take these matters into account in formulating long-term company policies. Accordingly, the counseling organization has attempted to state certain general problems which seem worthy of management's attention. These formulations take the form of reports. Two have been issued. The first is entitled "Attitudes of Short and Long Service Employees." The second is "An Outline for Discussing the Labor Situation at Hawthorne."

One last word. The Western Electric Company has made a study of the possibility of introducing personnel counseling in its plants at Kearny, New Jersey, and Point Breeze, Maryland. It has decided not to attempt to do so for the present. On the one hand, no one should take this fact as an excuse for jumping to conclusions about the value of the plan, and, on the other, no one should assume that the Committee recommends personnel counseling as a remedy for all industrial ills. It is not the business of the Committee to make such recommendations. The ends to be gained by a plan of this sort are important; the most effective methods of gaining the ends will vary from one organization to another and from time to time within any one organziation. To suggest that any particular program for doing personnel work can be introduced bodily into any industrial plant whatever would be to ignore the very researches which led up to personnel counseling. They showed the intricate interdependence in an industrial plant of all the elements of the social organization. Undoubtedly something in the situation at Hawthorne, above all the series of earlier investigations in human relations, made a particular form of personnel work peculiarly congenial and successful there.

V. The Interviewing Method

So as not to interrupt the story of the Western Electric researches, no effort has been made in this report to describe in detail the method of interviewing as it was finally developed at Hawthorne. Yet in the extension of similar investigations to other fields, interviewing will probably be of great importance, and it seems proper to give it more extended attention here. At the Conference, Professor Mayo, a member of the Committee, spoke on "Systematic Interviewing and Experimental Psychological Investigation in Industrial Plants," and at a meeting of the Committee held on April 23, 1938, Associate Professor Roethlisberger described further the method of interviewing developed at Hawthorne.

The method finally used at Hawthorne was the following. When the interviewer had been introduced to the employee, and the interview began, the interviewer made no effort to bring up any particular topic. Instead he "caught on" in a conversational way at any starting point mentioned by the employee, and so long as the latter was willing to talk made no effort to change the subject. A basic assumption of this procedure was that the employee would choose his topics largely in order of their importance to him. The interviewer talked only so much as he felt was necessary to show the employee that he was interested, to keep the employee talking, and to instill confidence. A skillful interviewer would listen carefully for signs of unusual or exaggerated feeling in what the employee said, and then, when he felt that the employee was otherwise "talked out," would try to press these topics further by proper questions and suggestions. But in no case would the interviewer try to impose on the employee discussion of a series of questions in which the employee had shown no interest.

This description of the interviewing method is a summary one. What is involved can perhaps be made clearer by an examination of the six simple rules for conducting an interview which have been drawn up by Professor Mayo. These rules will be referred to as Set A. They are the following:

1. Give your full attention to the person interviewed, and make it evident that you are doing so.

2. Listen—don't talk.
3. Never argue; never give advice.
4. Listen to:
   a) What he wants to say.
   b) What he does not want to say.
   c) What he cannot say without help.
5. As you listen, plot out tentatively and for subsequent correction the pattern that is being set before you. To test, summarize what he has said and present for comment. Always do this with caution—that is, clarify, but don't add or twist.
6. Remember that everything said must be treated as a personal confidence and not divulged to anyone. (This does not prevent discussion of a situation between professional colleagues. Nor does it prevent some form of public report when due precaution has been taken.)

These rules will be taken up in order, with the exception of No. 6, which needs no comment.

1. *Give your full attention to the person interviewed, and make it evident that you are doing so.*

The experience of sitting down to talk with a person who is continuously interested in one's feelings and opinions is new and refreshing for most people. Accordingly, the relationship between interviewer and interviewee is unlike most human relationships. But it cannot be created without the evident interest of the interviewer, and obvious inattention would destroy it at once. This rule is in fact no more than a principal rule of courtesy. Men experienced in handling other men make a particular point of paying close attention to what is said to them and showing that they are doing so.

2. *Listen—don't talk.*

This rule refers to the fact that the quickest way to prevent a man's expressing himself adequately is to interrupt him. An interviewer at Hawthorne was not to talk while the employee seemed to have anything left to say. But obviously this rule is not to be taken without qualifications. In an interview, a man is talking about himself, and anything which will help him to do so is a proper part of the procedure. Indeed, Professor Mayo emphasized the importance of talk on the part of the interviewer which establishes a pleasant relationship between him and the interviewee. There

are also a number of phrases, such as "Why?" "For example?" and "Tell me more about it," which can be used to help a man to develop his thought or put it in more concrete terms. For many persons, the sustained expression of their thoughts and feelings in words is a hard task, especially when it is performed for the first time. Therefore the interviewer should praise the interviewee, when appropriate, for his efforts. At Hawthorne, several of the employees went into their interviews apprehensive lest what they said should be used against them. Therefore the interviewers were instructed to explain to all employees that the interview material was to be kept confidential. With some particularly suspicious persons, it was necessary to repeat this explanation several times in the course of the interview. Finally, the interviewer will become aware that some topics have been inadequately discussed and that others have been conspicuously avoided. In a long interview opportunities are likely to arise which allow the interviewer to take up these topics, but of course he should not do so if he thinks they may be embarrassing to the employee. In short, these qualifications show that the rule is not absolute, but is a matter of discretion. The interview is a flexible instrument, and an experienced interviewer can take short cuts which would be dangerous for one less expert.

3. *Never argue; never give advice.*

The purpose of an interview is to elicit the sentiments of the interviewee, not those of the interviewer. The interviewer should never allow his own sentiments to be aroused by anything the interviewee says. He should rarely express surprise and never moral outrage. If an employee in an industrial plant says: "This is a terrible company to work for," the interviewer should never retort: "That's the wrong attitude to take." Instead he should ask the employee to amplify his statement or, perhaps, should restate it in an even stronger form. Experience shows that such restatement sometimes leads the employee to tone down his original remark. In any case, argument is more likely to stiffen the sentiments of the employee than to weaken them. Both arguing with a man and giving him advice imply the assumption of authority over him, and this assumption ruins the interview relationship. An interviewer must simply be a man who is available for conversation, never a man who can take action on what has been said. At Hawthorne every effort was made, both in the Interviewing Program and in the later personnel counseling, to make it impossible for the interviewers to take any position of authority.

4. *Listen to:*

(a) *What he wants to say.*

(b) *What he does not want to say.*

(c) *What he cannot say without help.*

The interviewer will notice that the interviewee wants to say certain things very much, and he will make a guess about why the interviewee wants to say them. He will also notice significant omissions. Some of the omissions may be things the interviewee does not want to speak about, either experiences which have been painful to him or topics such as sex in which he dislikes to tell his own story. Other omissions may be things he cannot speak of without help, often assumptions implicit in his thinking which he has never brought into the focus of consciousness. The interviewer should be on the alert for these assumptions, and if he can do so without embarrassment to the interviewee he should formulate them and bring them to the interviewee's attention for his confirmation or disagreement.

5. *As you listen, plot out tentatively and for subsequent correction the pattern that is being set before you. To test, summarize what he has said and present for comment. Always do this with caution—that is, clarify but don't add or twist.*

This rule means that the interviewer, as he listens to what is being said to him, must be fitting it into some general scheme of interpretation. Otherwise he will not notice the important topics which have been left untouched; he will not be able to direct the interview along fruitful lines. He must be forming a picture of the sort of man and the sort of experience which the interviewee is presenting to him, and he must verify his generalizations by laying them before the interviewee for his assent or correction.

This rule leads to the question: What scheme of interpretation shall be used? On this point Professor Mayo said: "The answer is that it must be clinical and empirical. Everything he (the interviewee) says is taken as a symptom. Dichotomous judgments —right-wrong, good-bad, true-false—must be ignored except as symptomatic in his thinking. It does not matter what his beliefs are; the relation of such beliefs to his personal history and his present situation is important. (How many social and political philosophies will survive such an approach?)"

A few comments on this statement may be made, taken largely from the extended description of the interviewing method by

Roethlisberger and Dickson.[1] They assert that the interviewer must treat what is being said in an interview as an item in a context. When the early interviewers at Hawthorne took the statements made by the employees about working conditions out of the context in which they appeared, they found that the statements were often meaningless. Only when they were taken as expressions of the total personal and social situation of the different employees did they become understandable. This general rule of interpretation has at least three corollaries.

First, the interviewer should not pay exclusive attention to the manifest content of the interview. This rule runs counter to common conversational practice. When two persons are talking together, each usually takes the statements of the other at their face value. As a result we have elaborate arguments about the New Deal and Communism. We pay a great deal of attention to what is being said, very little to why it is being said. The interpretation of interview material must reverse this process.

Secondly, the interviewer should not treat everything that is said as either fact or error. The case has been cited of the employee at the Hawthorne plant whose behavior toward her supervisor was conditioned by this supervisor's resemblance to a hated relative. The statements she made about the supervisor were certainly incorrect. The supervisor was not in fact the sort of man the employee felt him to be. But the correctness or incorrectness of her statements was a matter of no importance. The important thing was the meaning of her statements when seen in the proper personal context. Much interview material is in the same way neither fact nor error. When a man says: "My wages last month averaged only $35 per week. I used to make more," there are simple ways of checking his statement, and it can become the basis for appropriate action. When he says: "Working in this company is like being in jail," there is no conceivable way of checking. In fact, anyone who tried to verify his statement would be treated as a fool. It is neither true nor false. It is a symptom of a man's reaction to his experience. The interviewer to whom such a statement is made should try to establish what that experience is and has been. Of course it may also be well for him to find out how many persons agree with the statement—but that is another problem.

Thirdly, the interviewer should not treat everything that is said as being at the same psychological level. As Roethlisberger

[1] F. J. Roethlisberger and W. J. Dickson, "Management and the Worker," Cambridge, Harvard University Press, pp. 270-91, 1939.

and Dickson point out: "Sometimes the speaker is bored and is just making conversation. Sometimes he is poking fun at the interviewer. Sometimes he is nervous and apprehensive and therefore he is guarded in the statements he makes. Sometimes he is trying to make a favorable impression on the interviewer. At other times he is more earnest and is attending to and reflecting upon what is being said. Naturally, the meaning to be assigned to the speaker's remarks depends upon interpreting his responses in the light of the psychological context in which they occur." [1] Everyone at some time in his life has probably had the experience of wondering very much what a certain person "meant" by something he said, when the person in question, as likely as not, had no definite intention in his mind and was just talking idly, to be pleasant and polite or perhaps just to talk. This rule is designed to prevent such mistakes from being made.

The suggestion has often been made that the employees who were interviewed at Hawthorne were not saying what they really thought but simply what they believed the interviewers and management would like to hear. There is no doubt that this sort of behavior was characteristic of some employees some of the time, but no one who has had any experience in interviewing will believe that it can occur consistently in the course of an interview lasting an hour and a half. Any particular opinion which the interviewee wants to pass off as his own will come up again and again in the course of the interview and it will come up in connection with other opinions. If the interviewer is on the alert for the context of all comments which are made, he will soon become aware that the interviewee is trying to make a particular impression, and the very fact that he is trying to do so may become an important index of his social situation.

A word of caution is needed here. This report has perhaps given the impression that the interviews at Hawthorne were uniformly successful in securing free expression of the employee's sentiments and in developing an effective relationship between interviewer and employee. Many of the interviews were of this sort, but, in an imperfect world, many others were not. Some employees were interviewed a number of times. Some were particularly unintelligent or had no important problems which they needed to talk about. And some of the interviewers were of mediocre skill. Under any one of these conditions, the interview may turn into an effort to make conversation, useful only as a

[1] *Ibid.*, p. 276.

means of showing that an organization is taking an interest in its members.

The statements of the interviewee are always to be taken as items in the context of his personal and social experience. The question now is: What are probably the important aspects of this experience? In his address before the Conference, Professor Mayo spoke of the topics which the interviewer should try to bring up if possible in the course of his talk with the interviewee. These topics will be referred to as Set B. The outline he suggested was the following:

1. *If possible,* learn something of his early history and conditioning:

   The parental family:

   (a) The parental family and its neighborhood relations.
   (b) Its economic status and prestige.
   (c) Its geographical mobility.
   (d) Its changes of status and function—social mobility.

   The individual himself:

   (a) His early relation to parents, brothers, and sisters.
   (b) His transition from family to school; friends made at school.
   (c) His transition from school to work; friends made at work.
   (d) Whether illness interrupted development. (Not a medical but a social question—that of handicap.)
   (e) His relation to his wife and children, and their friends.
2. His habitual preoccupations and habitual assumptions; relate these to his personal history. Is he solitary? By preference or by circumstance?
3. His rituals (i.e., his habitual, daily routines of living):
   (a) Social—nonlogic.
   (b) Personal—skill. Social mana because of skill.
   (c) Asocial—obsessive and irrational.
   Estimate approximately the proportionate balance between these in a day.
4. Estimate approximately his *personal dependence-independence.*

In practice, the two sets of rules which have been presented here, those governing the conduct of the interview (A), and those specifying the topics which should be given particular attention (B), may become something very much like alternative methods of

interviewing. Emphasis on the first set of rules would lead to an interview in which the choice of topics would be completely in the hands of the interviewee. Emphasis on the second set of rules would lead to an interview in which the interviewer would make every effort to get the interviewee to speak on certain especially important topics connected with his social and personal experience. To quote Professor Mayo again: "A is better used in industry and ordinary social situations, where one has no right to proceed to direct questioning. B is usually the form used in hospitals, where the medical situation obviously permits a direct approach and is itself a guarantee against abuse of confidence. In hospitals, also, the limited time available favors the direct method. A is, however, superior in all respects as a method of interview. The appropriate information is given perhaps more gradually but in a fashion that is itself valuable as indicating the personal pattern. It is only by using A that one learns how best to understand and, if need be, to help the person interviewed. Hospitals, if wise, therefore use B only in combination with A."

VI. Self-Expression and Labor Unions

Mr. Harold J. Ruttenberg, Research Director, Steel Workers Organizing Committee, entered the Committee too late to hear the testimony presented at its early meetings. Nevertheless he became familiar with this material through reading an early draft of the present report, and was much interested in it, particularly in the work done at the Western Electric Company. He stated that the findings reached in the Western Electric researches coincided at many points with his own experience in industry. Accordingly, the Committee asked him to draw up a statement of his own, making any comments which seemed to him useful. This statement he submitted on January 15, 1940. It is summarized in what follows, with many quotations from the original.

Mr. Ruttenberg began by saying that he was naturally concerned with a particular scheme for handling industrial relations. "The particular scheme is known as collective bargaining. It is based upon two collateral organizations, designed to have sufficient strength to contend evenly with each other, but neither being so strong as to tip the scales against the other. One is the labor organization consisting of the employees in a designated unit. The other is the managerial force in that designated unit. Both organizations determine their relations to each other through round-the-table conferences, the results of which are reduced to writing in what is known as a collective bargaining contract. This contract provides both parties—the employees and the managerial force—with a procedure, known as the machinery of collective bargaining, through which they adjust their daily relations with each other at all points of contact, and discharge their respective responsibilities inherent in the specific agreements reached on their daily and long-range relations. The purpose of collective bargaining is threefold: first, to distribute the fruits of the business enterprise equitably among the employees through their labor organization in the form of increased employment, better working conditions, increased wages, and decreased hours; among the owners of the business through their management in the conventional forms for rewarding investors; and among consumers through better quality and lower prices; secondly, to establish mechanisms which give employees through their labor organization the greatest feasible operating

participation in the determination of production procedures and administrative policies designed to increase the output and distribution of goods and services; and, thirdly, to provide employees and management with peaceful means to work out their mutual problems and changing relations."

Mr. Ruttenberg stated that he was in agreement with the understandings reached in the course of the Western Electric researches. In fact, he had reached the same understandings in the course of his own experience in industry, although he was only partly conscious of some of them until he saw them set forth explicitly in the account of the researches. On the other hand, he felt that the manner in which the understandings had been applied by the personnel counseling program was inadequate. To illustrate this inadequacy and to confirm the findings of the Western Electric researches, he cited his own experiences, as follows.

"The urge for a means of self-expression is usually present in every individual in an industrial plant, and consciously or unconsciously (usually the latter) each individual constantly seeks some way to express himself. In the case of the six girls in the Test Room, the experiment in which they were participating provided them with a means of self-expression that they never found in their regular department. Although their supervision was greater than in their regular department, they felt relief from 'the constraint of supervision,' and were able 'to work freely without anxiety.' Their 'views were consulted and in some instances they were allowed to veto what had been proposed.' Such a voice in their working conditions inculcated in the girls a feeling of responsibility to demonstrate that what they had agreed to or proposed was right; the consequence: a steady rise in output despite alternatingly favorable and unfavorable changes in the physical conditions of their work. In addition to this motive for doing their best, the girls were given the freedom to work 'freely without anxiety' which made their daily tasks 'fun' instead of a drudgery. The cumulative effect of these factors was the 'social development of the group itself' which 'developed leadership and a purpose'; and with one girl in particular the urge for self-expression took the most obvious shape of seeing in her participation in the Test Room experiment a chance for 'distinction and advancement.' The results: the conclusion that the steady increase in output was not related to changes in the physical conditions of work, but to the development of an organized social group in a peculiar and effective relation with its supervisors.

"In his experience in industry the writer [*i.e.*, Mr. Ruttenberg] has found the urge for self-expression to be a basic factor, as im-

portant as the urges for economic betterment and personal security and, in some instances, more important.

"During the union organization wave in the spring of 1937, a committee of five employees came into the writer's office in Pittsburgh. They were from an industrial plant employing eleven hundred employees, half girls and women. The company is an internationally known concern. Its personnel policy has been used as an ideal example by spokesmen of industry for more than a generation. Every conceivable economic benefit was enjoyed by the employees. For the kind of work, wages were high. The forty-hour week had prevailed since 1933 with time and one-half for overtime work. Everyone got a minimum vacation of one week with pay annually, and employees with long years of service received as much as a month's vacation with pay. The employees had been organized into a form of the company union, which had been advertised by the company for years as having the complete confidence of the employees and being the most ideal form of labor organization. Knowing all this the writer was skeptical about the committee's claim that all the employees wanted to form a C. I. O. union, and gave the leader of the committee a batch of petitions addressed to the Congress of Industrial Organizations (then known as the Committee for Industrial Organization) asking for affiliation. They were then instructed not to return until a substantial majority of the employees signed them.

"A week later the committee returned to the writer's office, enlarged to thirty, with more than ninety per cent of the employees' signatures on the petitions. The leader of the committee in 1937 had been with the company continuously for thirty-three years, having begun employment at the age of twelve. All thirty members of the committee were officers of the company union, fifteen regular employee representatives, as they were called, and their alternates. They told the writer that they had voted the company union out of existence and decided to organize a C. I. O. local industrial union. They wanted to call a meeting of all the employees (something they never were permitted to do under the company union) for the twofold purpose of organizing a local union and deciding on the terms of a collective bargaining contract they wanted to submit to the company.

"In the meanwhile the company advanced wages another five per cent, and made every overture conceivable to satisfy the economic desires of the employees. Regardless, virtually every employee attended the first meeting, which ran counter to the writer's previous experience. The writer had always felt that a meeting could not

keep the attention of the audience for more than a few hours. This meeting, however, lasted five and one-half hours, from seven to twelve-thirty the next morning. The employees seemed just as fresh at the end of the meeting as at the beginning, and did not want to close it; many remained in the hall until two A. M. talking to each other. As chairman of the meeting the writer found it impossible to confine the discussion to questions under consideration. Every employee, it seemed, wanted to get on the floor and say something, and at least one hundred of the employees spoke, mostly about some personal experience. The writer finally brought the meeting to a close, but only by promising another one three nights later. To his surprise the writer found the next meeting attended by almost all the employees, and it lasted an hour longer than the first one. The writer observed in the faces of the workers as they alternately applauded, cheered, booed, and stamped their feet on the floor the same kind of emotionally satisfying expressions that he had previously observed among college students in the cheering section hailing their football team on to victory.

"During conferences with the management, which resulted in a mutually satisfactory bargaining contract, the writer became aware of the reasons for the behavior of the employees at their meetings. In brief, the management had been doing all the thinking for the employees in the plant for years in its zealous attempt to 'keep everybody happy,' as the plant manager explained. Although the contract provided additional economic benefits for the employees, these were of secondary concern to them. Throughout the five meetings in sixteen days that lasted a total of thirty-odd hours, the employees acknowledged the wage raises, ranging from eight to fifteen dollars a month, in a matter of fact way, and concerned themselves primarily with getting on their feet and talking individually or applauding, cheering, booing, and pounding their feet on the floor while others spoke. The employees seemed to get off their chest things that had been bottled up inside them for years.

"Many firms do not or cannot lavish such economic benefits on their employees, but even in those cases where employees form a union for ostensibly economic purposes, their urge for self-expression is inextricably tied up with their urges for economic improvement and security. Only in an extreme case as in this one, however, is it possible to observe the urge for self-expression apart from the other basic urges."

Mr. Ruttenberg felt that the existence of the urge for self-expression was one of the important findings of the Western Electric

researches. In the Interviewing Program, "the employees seemed to enjoy the opportunity of expressing their thoughts. They felt some kind of release." Account was taken of this understanding in planning personnel counseling, which revealed once more that some employees needed the opportunity for self-expression, but that the authority exercised by the supervisor prevented him from acting as a medium through which they could secure this opportunity. Nevertheless, Mr. Ruttenberg questioned the view that there exists a need for an "impartial, nonauthoritative, interviewing agency," and thought it inadequate. Certainly no judgment can be made on the evidence except to note that there is a barrier between the employee and the supervisor created by the authority which the latter exercises. In particular, he felt, as a result of his personal experience, that personnel counseling was not sufficient to bridge the gap, and that what the worker needed was not interviews but participation in a group organization. He noted that personnel counseling had not been transferred from Hawthorne to other plants of the Western Electric Company, and expressed the belief that it could not be introduced in other industries because the cost was prohibitive. He went on to say: "It is plainly observable that the employees in an increasing number of plants in American industry have been forming labor unions as a means of self-expression, and that a primary concern of these labor organizations is to bridge the gap between the employee and his supervisor." Of course the labor unions have other purposes, but these have been dealt with extensively elsewhere, by social scientists, industrialists, and labor leaders.

In fairness to personnel counseling, two points should be made here. First, it has a number of functions besides that of providing the employees with a means of self-expression. These functions are described in an earlier section of this report. Secondly, one of the most important statements which can be made about personnel counseling is that it has apparently worked well at the Hawthorne plant, but there is no implication in any of the accounts of the program that it can be successfully applied in all industrial situations. There is little reason for generalizing from the program, either in a favorable or in an unfavorable sense. The needs of individuals are more or less permanent, but the effective means of satisfying these needs may vary greatly with time. Even when their satisfaction is assigned to a formal procedure, such as that of personnel counseling or organized labor, the procedure is always in danger of becoming mechanical and sterile. The important point is that Mr. Ruttenberg's experiences and the Western Electric studies reveal the existence of the same vital needs.

Mr. Ruttenberg noted that an independent union, which had formerly been a company union, existed at Hawthorne, and that "there was . . . a feeling among the officers of the company that in discussing the affairs of the plant with the employee representatives, neither side talked about the problems which were really vital at the work level. Management felt that the findings of the counselors might be helpful in this respect." Mr. Ruttenberg stated that company officials who meet regularly with representatives of their employees from unions which are free from company control, influence, or domination, find that they are always talking about things which are "really vital at the work level." Furthermore, in his experience, many company officials are not prepared to talk about the really vital things at the work level, and interpret the union representatives' continual concern with such things as an attempt to infringe upon management's prerogatives. For example, employees are constantly seeking ways and means of securing a voice in the determination of their working conditions, and if they do not exercise their influence directly, they do so indirectly. This conclusion was reached in the experiment of the Bank Wiring Observation Room.

"It was found that 'although the employee participates least in the technical organization, he bears the brunt of most of its activities.' As a consequence, an informal organization developed among the Bank Wiremen long before they participated in the experiment. The purpose of the informal organization was essentially protective, which made its activities negative. The group through its leaders opposed 'rate busters,' members of the group who exceeded expected production levels, because of fear that management would set higher output standards and reduce their per unit earnings accordingly. Likewise 'chiselers' were opposed, as they jeopardized the earnings of the entire group by slacking on the job. And, of course, the group opposed 'squealers,' because they tattled on its secret doings. It was also found that this informal organization gave the employees 'a certain feeling of security,' and that 'the principal discovery of the research program' at Hawthorne was that the employees were 'unconsciously attempting to protect themselves (through their informal organization) from real and fancied consequences of supervisory practices and technical innovations.'

"In this respect Professor Mayo has observed that 'these informal organizations much resembled formally organized labor unions.' The writer has found this to be the case in his experiences. As a matter of fact, in going about the task of organizing the employees in a given plant into a labor union, the writer has consciously sought

out the leaders[1] of these informal groups throughout the plant, interested them in taking a lead in forming the union, and found that upon their joining the union the members of the informal organizations followed suit. Actually, unless the leaders of the informal organizations can be recruited into the union, the task of forming a union in the plant is made difficult, if not impossible. Given a chance to form a labor union in the plant, the leaders do so because, like some of the groups studied at Hawthorne, they feel 'preoccupations of futility with regard to promotion.' Although they form the labor union for the added strength their respective informal organizations get by combining with the other informal organizations throughout the plant, the leaders, in many cases, see in the union a chance to get on in the world.

"Thus the leaders of the informal organizations take up leadership in a formally organized labor union, in part, because of the 'preoccupations of futility with regard to promotion,' and the rank and file join the labor union because, as the Interviewing Program at Hawthorne revealed, something in their experience of industrial life produces in a number of employees 'a conviction of personal inadequacy.' Mr. Chester I. Barnard has observed that informal organizations serve as 'a means of maintaining the personality of the individual against certain effects of formal organizations which tend to disintegrate the personality.' Although this statement was made about the top officials of an organization, it applies with equal force and truth to the employee at the end of the line, and as a consequence he joins a labor union for the same purpose that top officials form informal groups of their own (though in the latter case they may do nothing more than join the same golf club)." Naturally, once the trade union is formally organized, the process tends to repeat itself, and informal groups spring up within the union.

"When the informal organizations in a plant are combined into a formal labor union, their purpose may continue to be negative or may be converted into a positive and constructive purpose, depending upon the attitudes and policies of management and the peculiar problems flowing from them. The writer cites three typical experiences in this connection. In the first case, the negative purpose of the informal organizations was converted into a positive one; in the second, the negative purpose of the informal groups was enlarged;

[1] Before becoming acquainted with the Western Electric researches, Mr. Ruttenberg had always referred to these leaders as the employees who exercised influence over other employees, who had the confidence of their fellow employees; in labor union parlance, "the men with a following."

and in the third case, the negative purpose was enlarged and then converted into a positive one.

"Number One Company operates three plants, one of which was on the verge of being closed permanently. The manager of this plant had been in charge of its operations for more than a generation; his method was to produce by authority. Orders were given as his fancy guided him, and anyone who did not like them, or the manner of his giving them, could carry them out or seek a job elsewhere. The employees naturally banded together into informal organizations for protection, and these informal organizations, as was observed at the Hawthorne plant, secured considerable co-operation from the minor supervisors. When confronted with the necessity of abandoning operations at this plant, the top officials decided to remove the old manager and give the plant a trial for another year. Shortly before this took place the employees formed a C.I.O. industrial union. With the change in managers, the local union leaders, who had been leaders of the informal organizations in the plant for years, offered to co-operate with the new manager to increase productive efficiency. For example, jobs for which twenty hours had been set as the standard under the premium system established by the old manager, were completed in five and one-half hours under the new manager—with all premiums or incentives of any kind eliminated. Suggestions poured forth from the employees on ways of making the operations more efficient. The results were apparent within six months: the company's efficiency rose by fifty-three per cent, and six months later the company announced the plant would be kept in operation indefinitely.

"This case confirms the conclusions reached in the Relay Assembly Test Room and Bank Wiring Observation Room experiments. In the former the girls organized for a positive and constructive purpose. In the latter experiment the men organized for a negative and protective purpose. The contrast: the Test Room girls increased output and were consulted on technical and other changes, while the Bank Wiremen pegged production because of 'having to respond to technical changes which they did not originate.' When the employees of Number One Company were denied a voice in the determination of their technical and other conditions of work they reacted like the Bank Wiremen, but when they were given an opportunity to determine, in part, their technical and other conditions of work they reacted like the Test Room girls. The new manager gave the combined brain power of the working force expression, which had been frustrated by the old manager.

"Number Two Company is a huge enterprise, much in the news

these last few years. The basis of its operations is the assembly line. The employees, as elsewhere, had organized into informal groups starting the first day the assembly line was put into operation more than a decade ago. Through their informal organizations the employees had perfected ways and means of keeping production at a certain level, just as the Bank Wiremen did. Each year the management changed the speeds and rates of pay of the assembly line; the employees were not consulted. The new speeds and rates of pay were announced after the management worked them out through its own Time Study Department. When they were announced, the employees either accepted them or quit their jobs. Only a few were free to do the latter; the vast majority had to stay with their jobs and work out their problems as best they could. Denied a direct voice in the establishment of assembly line speeds and rates of pay, the employees exercised an indirect influence through their informal organizations. In 1936 and 1937 the employees formed a C.I.O. industrial union, for which ninety per cent of the employees voted in a governmentally held election in 1939. The management, unlike Number One Company, opposed the formal organization of its employees. Consequently, the employees continued the negative purpose of their informal organizations when they merged them into a formally organized labor union; in fact, they enlarged the purpose of their organization and accordingly enlarged its negative activities.

"One of the purposes, as previously noted, of the informal organizations was to peg production. Prior to organizing into a labor union the employees for years had been doing this through their informal organizations. They did it, as previously noted, because they were denied direct participation in the determination of assembly speeds and rates of pay. After organizing into a formally organized labor union the employees requested of management direct participation in the setting of speeds and rates of pay. Management rejected the request; argued that such a request, if granted, would be an infringement on management's prerogatives. Denied direct participation, the employees continued to participate in setting assembly speeds and rates of pay through the indirect methods they had perfected over a long period of years. When placed on a larger scale than under the informal organizations, the pegging of production became clearly observable to top management; minor management officials knew all about it, even co-operated with it, as did the minor management officials at Hawthorne who recognized the leaders of the informal organizations and dealt with and through them.

"Upon learning of these practices, top management officials charged the employees' union with sabotage; for exemplary discipline fired the leaders in one department, who had been pegging production long before they organized a formal labor union. The rank and file of the employees, who, long before the labor union was created, followed these leaders in pegging production, defended their leaders by refusing to work until they were reinstated to work. The management refused, and closed the entire plant. Union spokesmen charged management with conducting a lockout; management spokesmen charged the union had called a strike. The dispute raged for two months; finally it was settled on a compromise. Management would continue to set speeds and rates of pay by itself, but if any speeds or rates were unsatisfactory to an employee or group of employees, then the management would reset the speeds and rates in co-operation with the employees through their representatives. Not all is in order in this company's plant now (January, 1940), nor is it likely to be until management clearly comprehends the basic urge for self-expression of which pegged production is merely a manifestation.

"Number Three Company now enjoys the benefits of the positive and constructive activities of its employees' union, as does Number One Company. But Number Three Company went through a year and one-half period during which its employees enlarged their negative activities before engaging in positive and constructive ones. The central point of difficulty was the establishment of piecework rates. Prior to the organization of the employees into a labor union, the management had set piecework rates itself, and when and if the employees exceeded their expected production and earnings, the management summarily reduced the piecework rates, so that the employees would have to increase their output to maintain their weekly earnings. Consequently there naturally developed an informal organization among the employees to peg production at a certain level, as the Bank Wiremen did. After the employees merged their informal organizations into a formally organized labor union, they were able to make higher weekly earnings by cutting production. The management had raised their piecework rates from twenty to sixty per cent to prevent them from organizing the labor union, but in vain. Once they were organized into the labor union, the employees discovered that they could make more money each week with a cut in production, which they immediately put into effect, bit by bit each week.

"Eventually the management complained that production was falling off, and admitted its costs were out of line competitively

because it had raised its piecework rates to uneconomic levels in its effort to thwart the creation of the union. The employees naturally resisted the management's request for a reduction in piecework rates. The management argued that the employees could maintain their weekly earnings by raising output, but the employees were interested in their weekly earnings foremost, and if they could realize satisfactory weekly earnings on a given output, they were not interested in raising output to maintain these earnings.

"An agreement was finally reached pegging piecework rates for a period of one year. The company's product changes yearly; the management and employees through their union establish the piecework rates each year by joint determination, and they continue unchanged until the following season. Knowing that their rates would not be changed, the employees instead of contriving to restrict output co-operated to increase it. To everyone's surprise output more than doubled; management benefited from greater output per day; the employees benefited from substantially higher weekly earnings. At Hawthorne 'the workers were banding together informally in order to protect themselves against practices they interpreted as a menace to their welfare.' This is the way the employees of Number Three Company felt about piecework rates until they were pegged for a year. When this was done the employees gained confidence in their management and had no further reason for pegging production and, in mill language, 'gave it the works.'"

Mr. Ruttenberg stated that, so far as it was possible for a partisan, he has "cited the foregoing experiences objectively, his sole purpose being to give current meaning to the findings of the Western Electric researches; and in relating these experiences to the findings at Hawthorne he has attempted to show how characteristic they are of industry generally—that is, if similar researches were conducted in every industrial plant in American industry, the same findings, with only variations in detail, would be made."

Mr. Ruttenberg further stated that there was one finding of the Western Electric researches which he did not relate to his experiences, because it did not seem necessary to do so. In the Bank Wiring Observation Room "failure of communication in both directions, up and down," was observable.

"This breakdown of communication in industrial management organizations is so common that to cite examples of it would be repetitious. With only rare exceptions, the writer has observed the breakdown of management's communication system in every industrial plant with which he has anything to do. The organization of almost every labor union in an industrial plant with which the writer

has had any connection has been preceded by the distortion of top management officials' attitudes and policies by minor functionaries. And one of the first concerns of the newly organized labor union is almost invariably seeing to it that policies agreed to by top management officials are carried out all the way down the line, and not subject to the distortions of minor functionaries' prejudices, personal limitations, or incompetencies. Of course, this problem of communication exists in all types of organizations, the labor union being no exception, and in his daily organizational functions the writer is constantly aware of difficulties encountered in having policies executed all the way down the line in a manner that preserves their original spirit and accomplishes their designed objective."

Mr. Ruttenberg agreed with Mr. F. W. Willard, another member of the Committee, that the three basic factors which have contributed to the record of no labor disturbances at the Hawthorne plant of the Western Electric Company for the last twenty years are probably (1) job security, (2) economic rewards for work, and (3) the job environment. "Although it may be safely observed that most labor-employer controversies are the result of inadequate job security or economic rewards for employees, even those industrial concerns which meet these conditions are not necessarily free of such controversies. And where either or both of these factors may be the cause of a labor-employer controversy, the job environment—that is, the employee's urge for self-expression, his relation to his supervisor, and his impulse to break through the barrier created by the authority held by his supervisor or otherwise overcome the frustrations of his industrial life—may likewise be a basic factor."

VII. Extra-time Allowances

At a meeting of the Committee held on December 15, 1939, Jacob J. Blair, Assistant Professor of Economics, School of Business Administration, University of Pittsburgh, spoke on the subject of "Extra-time Allowances." Harold J. Ruttenberg, a member of the Committee, had suggested that Mr. Blair should testify, in order to illustrate the kind of work that is being done in one of the nation's great industrial areas, that of Pittsburgh. Mr. Blair's remarks are summarized in what follows.

About two and a half years before, Mr. Blair had begun a survey of the Pittsburgh industrial district, made up of Allegheny, Beaver, Washington, and Westmoreland counties, in order to determine what methods were being used by plants in this districts in setting output standards. Contact was made with about 360 different plants. Since the plants were in many instances subsidiaries operated by other companies, this number does not represent different companies. The only basis on which plants were selected was that they should employ at least 100 persons. As a matter of fact, they ranged in size from 100 to 11,000 employees, so that the survey included both small and giant concerns. In these plants, Mr. Blair interviewed the person in charge of rate setting, and after asking him a series of standardized questions, tabulated the information received. From this body of information, the evidence presented to the Committee was drawn.

The first question is: What do we mean by an output standard? When a task in shop, factory, or mine—even in some instances in an office—is strictly defined according to duties and time, an output standard has been set. The time element is the most significant aspect of the definition: an output standard is a standard time for performing a certain task. How important such standards are to the management of a company is clearly evident to anyone who has an extensive knowledge of business. They enable management to make some estimate, in advance of the completion of a job, as to just how long that job is going to take. They provide management with an effective instrument of control over one of the most variable factors in production—the human element. Output standards are then co-ordinated with other devices, such as those of budget, cost

accounting, and scheduling, all directed at the solution of the problem of control. To use Mr. Blair's own words: "Because output standards are so closely related to these various control management devices, their use is very extensive in industry. It is, in fact, rather difficult to imagine any kind of task assigned to a man in a shop or mill or factory or mine which does not have assigned to it some definite time limit."

In particular, of course, output standards are commonly associated with either a piece-rate wage payment system or a bonus system. Somewhat more than half of the plants studied tended to use either one or both of these systems.

An output standard, as it is established in practice, may be broken down into two elements: first, the operation time—the manual operation or machine time which is required in completing the given task—and secondly, the extra-time allowances. There are four extra-time allowances which are usually added to the operation time. The first is for differences in skill and effort between the average worker employed on the operation and the worker whose performance was studied in determining the operation time. The second is for unavoidable delays which occur during the operation and are beyond the control of the worker. The third is for personal needs, and the fourth for fatigue. An output standard, then, takes into consideration not only the actual manual and machine time required to finish a task but also that part of the total amount of time consumed for other reasons in the course of a day's work which may properly be applied to the given unit task.

The extra-time allowances formed the particular subject of Mr. Blair's remarks. When asked by the Chairman of the Committee to speak on any piece of research within the field studied by the Committee, Mr. Blair decided to speak on this topic, which he felt was of immediate concern to anyone interested in the problems of industrial relations. Extra-time allowances are related to two aspects of work in industry. "In the first place, they determine to a very large extent the difficulty of the task. For example, if the fatigue allowances, plus the other three allowances, are not great enough to compensate for the requirements of the particular job, it is quite evident that that job will be made so much more difficult because of lack of time in which the operator can rest. . . . In the second place, extra-time allowances are closely related to the earnings on a given job. If the allowances, for example, are quite tight—if an insufficient amount of time is allowed—and if the particular worker is engaged on a job which is compensated on a piece-rate or bonus

plan, obviously he will have greater difficulty in meeting the task. Consequently, his earnings will be somewhat lower."

For the moment, Mr. Blair asked the Committee to consider not the special problem of establishing extra-time allowances, but rather the general problem of setting output standards. Output standards are set by two main classes of methods: first, the so-called empirical methods, and secondly, the stop-watch or time-study methods. Of the 360 plants under investigation, stop-watch methods were used in 106, controlled by some 52 companies. The average number of employees in plants operated by companies using stop-watch methods was approximately 400, as compared with an average of a little over 200 in plants using empirical methods.

Empirical methods involve primarily the use of judgment and experience rather than analysis and precise measurement. When they are adopted, management is interested in knowing only the over-all time, that is, the time elapsed from the beginning of an operation to its completion. According to this method, the task is not broken down into the different elements of which the total is composed. It may be well to continue in Mr. Blair's own words: "When the empirical methods are used, they may be used in any one of four different forms. The results, however, in each case are almost the same. In the first place, the foreman may be asked to set the task on the basis of his experience or what he thinks the time element on that job should be. The second method is to take an average of the past performances on that or some similar job; . . . these averages . . . are then applied to other jobs, and the new rate is then established on that basis. I might add that in some cases this procedure is greatly elaborated. I know of one company in the Pittsburgh district which spent better than a year in setting up standards by this method. The third type of empirical method employed in the Pittsburgh district is the use of pace setters. A pace setter is usually a foreman or a worker who is paid a special rate somewhat higher than the rate applicable to his occupational classification, this special rate being paid because of greater skill and greater willingness to put forth an effort. And finally, a fourth type of procedure is that of the use of machine speeds. Machines . . . are sold by machine and tool manufacturers usually under certain definite specifications. That is, they are guaranteed to turn up so many revolutions a minute and accomplish so much work within a certain limited period of time. When you have that information, you use the machine . . . to set the task, so that the machine really becomes the pace setter when used in this manner."

This statement makes clear a point which has already been

brought out. It is the following. Except for the one plant which adopted the elaborate procedure of taking averages of past performances, practically all the plants studied set the output standards of the different jobs, both piece-rate and straight time jobs, largely on the basis of what responsible persons thought was the time necessary to complete a particular task. Human judgment, unaided by methods of precision, was the decisive factor.

The empirical methods of setting output standards may be considered under two heads: first, how the methods were applied, that is, how the foreman proceeded to estimate the time required to complete a task, and, secondly, what the conditions were under which the standard for the task was established. "The usual method in the application of any of the empirical procedures, whether it involves the use of pace setters or the use of the foreman's opinion or judgment, the use of machine speeds or the use of averages, is to take relatively few operations. Perhaps one might say, just for the sake of making a point and not to be held too strictly to the accuracy of the number, . . . that an average of about 20 operations would be used to set the time limits by any one of these particular methods, and sometimes, but rather infrequently, there may be only one or two operations. The over-all time is taken from the time the task begins to the time it is completed; the difference between those two times, if the number of operations is small, is then averaged, and that time is then used without further correction for the output standard of that particular job. There is, in other words, no attempt to break that job down into its parts or its elements and study each element separately from the other elements."

Mr. Blair turned next to the conditions under which output standards are established. They may be divided into three classes. First, there are the physical conditions surrounding the job: temperature, lighting, noise, arrangement of the work, position of the tools, and so on. When empirical methods are used, there is little if any effort made to analyze these conditions for the purpose of improving them, that is, to make the job easier.

Secondly, there are the conditions involved in the training of the rate setter, the rate setter in this case being the superintendent of the department or the foreman. He is a practical man. "That is, his training is to a very large extent limited to the mechanical operations involved in the job and does not extend outward to the human element and some of the human problems involved in production. His interest as a foreman or a superintendent is that which is quite typical of the operations man, that is, cost. Under the influence, then, of the primary interest in cost and in operations, the tendency

is that the foreman, when required to set a new rate, will underestimate the time required rather than guess on the other side, that is, overestimate the time required. The strange thing about it is . . . that the men seldom seem to find these tasks to be too severe. When a limit is set too severely, the foreman is usually willing to revise the standard."

The third condition which affects the reliability of the extra-time allowances is the organizational status of the rate setter. That he is a production and operations man has already been indicated. He comes under the superintendent or general manager in charge of operations. Being highly cost-conscious, he tends to keep the time down in order to keep costs down.

Under the empirical method of setting output standards, the task is not broken down into its elements; instead the over-all time is taken, and only the operation itself is considered. In some cases an arbitrary percentage is added to the over-all time, in an amount which is believed sufficient to compensate for fatigue and other similar factors; but for the most part no specific extra-time allowance is made. Nevertheless, in shops where these methods are used, there exists a broad assumption that if enough studies of a particular operation are made, the differences in time will cancel each other. That is, there will be some variations which are high and some which are low; the plus and minus signs will cancel each other, and in the final average some form of extra-time allowance will automatically be made. A reasonable conclusion is that if it ever is made, it will be made because of an element of chance and not because of any scientific estimate of what the extra-time allowances should be. Finally Mr. Blair said: "There is the second factor which I want to emphasize again, and that is the position of the foreman as a rate setter. I think it can be questioned whether the foreman, with his interest in costs and operations, should be placed in charge of this particular responsibility."

Mr. Blair turned next to the second of the two methods of setting an output standard: the stop-watch or time-study method. The procedure in this case is quite different. Under the empirical method, the over-all time was taken as a basis for setting the output standard; under the time-study method, the usual procedure is to break the task down into its different elements. Furthermore, a specialization of labor is required. Under the empirical method, the foreman or superintendent sets the output standard; under the time-study method, the job of breaking the tasks down into their elements becomes so highly specialized that trained men are generally used. Finally, in the time-study method, as the name implies, accu-

rate measurement is emphasized, the measurement running to an accuracy of a thousandth of an hour or even one one-hundredth of a minute.

Since under the time-study method an attempt is made to break the task down into its elements, separate attention can be given to the four different kinds of extra-time allowance. The fact should be remembered that the extra-time allowances are corrections applied to the output standard of a particular task in order to allow for differences in skill and effort, unavoidable delays, personal needs, and fatigue.

The first extra-time allowance is designed to correct for the difference between the skill and effort of the worker whose performance was observed in the time study and the expected skill and effort of the body of workers to whom the output standard is to be applied. In ten companies in which the time-study method was used, the only correction made for this difference was an increase or decrease in the fatigue allowance. That is, no attempt was made to study differences of skill and effort apart from the other extra-time allowances. They were all lumped together. Some companies justified this practice by saying that they studied the average worker and as a result did not need to add to or subtract from the observed time. Others said that they studied not one worker, as is the practice in certain plants, but several. That is, they studied first a very highly skilled worker who was putting forth good effort, then a man of average skill and effort, or as nearly as they could approximate to that individual, and finally a man whose skill and effort were considerably below average. These three results would be averaged, and the mean obtained would be the expected level of accomplishment for the normal worker. Whether the average worker was selected or several workers were observed, there was in the mind of the time-study engineer some recognition of the need for an allowance for differences in skill and effort.

In response to a question, Mr. Blair agreed that the allowance for differences in skill and effort raised the problem of what was an average worker. "An average worker," he said, "in the parlance of the shop is one who, as one industrial engineer defines it, is neither of the highest nor of the lowest grade, and that is about as close as they come to it." He then went on to illustrate further what he meant by the allowance for differences in skill and effort. "Let us take a hypothetical case and suppose that we were all engaged in doing some similar task, or to make it even simpler, let us suppose we were doing an identical task in some shop or mill. The management would want to know what would be a reasonable output to

expect from the group, taken as individuals and as a whole. There would be two ways of determining that. One would be to study the performance of every man in the group and then take the average of those performances. A second method, and the one usually used in industry, is not to study every man, because that in some cases might involve one or two hundred people, but rather to study one or just a few—possibly three—and then set the task for all on the basis of the observed times obtained from the study of one or a few workers. The difference between the time in which the one worker or the few workers complete the task and that of the expected performance of the average of the group—that is, the group as a whole—is corrected for by the use of this extra-time allowance that we are now discussing."

In some cases, no correction was made for differences in skill and effort, but in others an explicit correction was made, and one of the members of the Committee asked how the value given to the correction was obtained. The question can be put in the following way. As a result of an experimental operation, a number n is obtained. That number is then put through some arithmetical operation with the help of some other number m in order to get a result. What is m? Mr. Blair explained that $n \times m$ was the correction, and that m is a mathematical value based upon a series of experiments done by industrial engineers, not necessarily on jobs of the particular sort to which the correction was to be applied. The standard values are taken from a handbook. At this point, Mr. F. W. Willard, a member of the Committee, interposed. He said: "During the past 40 years, there have been some very careful studies made upon a great number of more or less standard operations. It started, as of course you all know, 40 or more years ago with the classical work of Frederick Taylor in which he did a very careful experimental job, and those standards upon a great many types of operations which have changed very little have been largely accepted, and I am wondering if they do not go back to these old experimental data and use those as correction factors." Mr. Blair agreed.

After this interlude, Mr. Blair returned to the methods used to correct for differences in skill and effort between the operator observed in time studies and the so-called average or normal operator. The fact will be remembered that ten of the companies studied made no explicit correction but simply a single allowance for all causes. Forty-two companies did make an explicit correction. "Twenty-five of these companies simply add an arbitrary percentage based on their judgment of the differences of skill and effort between the worker observed and the average or normal worker. Seventeen

companies require time-study engineers to use either the speed-rating method or the leveling-factor method. The speed-rating method is a system used by Bedaux engineers; they interpret all operations in terms of a norm which they set at 60. Then the skill and effort of every operator observed are evaluated in terms of this norm of 60. The result may be a 50 operator, an 80 operator, a 90 operator, or a 40 operator, whatever the case may be, and if he is below 60, then the task time is increased by the amount of the fraction. The leveling-factor method, which I believe was developed by the Westinghouse Manufacturing Company, uses a set of values which are already set up. . . . These values cover six different degrees of skill and effort, ranging from very superior to very poor, and against each of these degrees of skill and effort a mathematical value is given. This mathematical value was determined by Westinghouse engineers some years ago and is a result of a number of experiments on an identical operation. Men of different skills using different efforts all performed this same operation. Their times were observed, and the difference between these times provided the basis upon which these allowances were set up."

At this point Mr. Blair made a very important statement: "I think it is apparent that whether we use the speed-rating system or the leveling-factor system, it is still necessary for the time-study observer to use his judgment whether a man is of good skill or of average or poor skill . . . so that judgment is a most important factor here in assessing the value of the correction to be made."

Ten of the 17 companies which required time-study engineers to use either the speed-rating or the leveling-factor method attempted to obtain standardized judgments on the part of the time-study observers by offering special courses in training. One method of training requires the time-study observers to speed rate or to level a motion picture of an operation. By working on such pictures they are able to make uniform judgments as to the skill and effort being expended.

The second extra-time allowance is that for unavoidable delays. Unavoidable delays are those which are beyond the control of the worker. Thirty-two companies simply combined unavoidable delays with fatigue allowances or personal needs allowances, without attempting to break down the whole into its parts. Of the companies which made a specific allowance for this purpose, three determined the allowance simply by judgment or guess, and fourteen made elaborate delay studies. Here Mr. Blair may be quoted again: "These delay studies are frequently referred to as all-day time studies, and that gives you a good idea as to the approximate length

of time that is taken to determine the amount of allowance for this delay. Some went even beyond this point. I was permitted to see some delay studies which covered a period of perhaps a month and a half. I might add that the purpose of this very elaborate study of delay was not to set the allowance more accurately but rather to smooth out the operation itself and make it more efficient. The average time for these delay studies is, as I said, about one day, and during this time only the delays are recorded. That is, if an operator's machine breaks down, that fact is recorded on the time-study form; if he is interrupted by the foreman, that is also recorded, or if he has to go to the tool room to get more tools. In the course of the day, several of such conditions arising, they are all analyzed and proper allowances are worked out for them. . . ."

The third extra-time allowance is that for personal needs. Only twelve companies gave special consideration to personal needs allowances. The other forty companies combined personal needs allowances with the fatigue or delay allowances without any breakdown or separation. Nine of these companies gave a flat allowance for personal needs amounting to between 2% and 5%. One plant determined this time merely by judgment, that is, giving what seemed to be necessary.

The fourth extra-time allowance is the fatigue allowance. In Frederick Taylor's original work, particularly in the pig iron handling experiment, he allowed for fatigue in a manner quite different from that customary today. He set aside a definite time in which the operator was required to rest. Today the allowance is simply added to the necessary operation time, and is not set aside as a required rest period. In twenty-four of the companies studied by Mr. Blair a flat allowance was given. This allowance ranged from 10% to 15%, the modal value being 10%. In nineteen companies, the time-study engineer decided according to his judgment of the physical conditions of the job the fatigue allowances which were to be given. In six plants the fatigue allowances were set according to formulas or curves, the exact percentage to be allowed for fatigue being taken from these curves according to certain conditions peculiar to the operation in question, the length of the operation cycle being the direct consideration upon which the allowance was determined.

Mr. Blair had made an effort to determine just how much extra time was allowed for fatigue, but he lacked the opportunity to check the actual records. According to the opinions of the time-study engineers consulted, the median of the minimum values given was 5%, of the maximum values 25%, and the average was about 15%.

Mr. Blair turned to the conditions under which the extra-time

allowances were determined. When stop-watch and time-study methods were used, in contrast with the procedure followed under the empirical methods, the physical conditions of work were very carefully analyzed. All external factors, such as heat, noise, weight and best arrangement of tools, the flow of materials, and so on, were studied with the object of standardizing them as much as possible. Thirty companies required that before an output standard was set, a full description of the product be given, that the flow of materials—that is, the sequence of the materials from operation to operation—be also indicated, and finally that the equipment used be carefully studied as to the condition of the tools—the keenness, for example, of cutting tools—the revolutions per minute of machines, the condition of belts, and various similar factors.

"Twenty-nine companies required that the time-study men should have high school or college training, nine specifying that they preferred college-trained engineers, the other 20 indicating that they would be willing to accept high school men provided that they had some experience in operations and also knew something about handling men. The nine companies which required college men also had, I think largely as a matter of coincidence in most cases, rather elaborate training programs by which these men were taught the methods used in setting output standards and the determination of extra-time allowances. As was the case in plants using the empirical methods, the function of setting output standards was allocated to the operations department in spite of the fact that, as I pointed out earlier, this task is closely related to the problem of industrial relations. In the case of three plants this seemed to have been recognized perhaps more than in the cases of the others, because there the function of setting output standards was placed under the personnel officer and the industrial relations department."

In concluding, Mr. Blair expressed the hope that he had indicated the importance of human judgment in determining the extra-time allowances. The amount of time allowed by the foreman or the observer for the four major reasons will determine the relative difficulty of the task. Inasmuch as industry is being rapidly mechanized, and power-driven or pacing conveyors are being installed, their speeds being determined by time studies, this aspect of the exercise of judgment becomes a very important one. The problem of determining the time to be allowed for a task is becoming just as important as that of the wage to be paid, and in fact there is a close relationship between the two.

He pointed out again that, in regard to fatigue, ideas have changed considerably so far as shop practice is concerned. In Taylor's experiments the worker was required to take definite rest periods, and at the end of the rest periods he was put back to work. Under present conditions, the output standard includes allowances made for various purposes, and the worker may or may not employ the extra time for these purposes, as he sees fit. Taking the extra time means that his production will fall. Not taking it means that he will produce more, and his earnings will be increased. In industry we find that in fact these allowances are being used more and more as means by which a worker can increase his earnings and not for the purposes for which they were originally intended.

Considerable discussion followed Mr. Blair's remarks. In the first place, the Chairman asked whether Mr. Blair had any evidence in regard to the relative merits of the empirical methods, which involved judgment almost entirely, and the time-study methods, which involved a certain amount of measurement and a certain amount of judgment. Mr. Blair replied: "I would immediately say that under the stop-watch or time-study methods you should, other things being equal, get a more accurate result than under the empirical methods. The evidence that you do is rather difficult to provide, and I have even wondered if it could be definitely established inductively or whether we have to take the opinion of various people based upon their observations of accomplishment. Time-study engineers say that, taken generally, they believe that the time-study methods are within 5% of accuracy. On what basis they make that statement I don't know. The way they generally decide whether a task is fair or not is whether the worker is able to 'make out' under that task, that is, whether he is able to make more than his guaranteed daily earnings, and only in about 5% of the instances do they feel that the standards as set up were such that the worker could not make out or that he made too much."

The Chairman mentioned briefly the different meanings given to the word *fatigue*. The word is in existence, and for practical purposes it is used by all of us in describing our feelings. The very briefest introspection will show that in fact the sensations we refer to as fatigue are exceedingly different sensations. We can all remember the fatigue from a short run, the fatigue from a long day's work, and the fatigue from a small amount of work on a hot, moist day. They are different sensations, and they correspond to different physiological states, so different that it is entirely correct to say that there is no such thing as fatigue, but rather a great many fatigues.

The Chairman amplified his remarks at this point. He said: "If I stand at attention without twitching my legs, I usually fall down in a faint within probably five minutes, and nobody can hold the position for half an hour. There is a feeling of intense fatigue before the fainting. That is due essentially to certain changes in the circulation which throw a burden on the heart. If you run a 220- or 440-yard dash, your fatigue is of a very different kind. It is due to oxygen consumption. If you run a marathon, it may be due to depletion of the glucose supply of the body. If you put yourself into an airtight uniform, such as people have tried to work out as a protection against mustard gas, and walk for half an hour on the level, you are completely exhausted. Your heart goes up and strikes a maximum and stays there, and you stop pretty soon. In that case, and in the case of work in humid, hot weather, the fatigue is due very largely to the immense skin circulation that is set up."

Besides these distinct physiological states, there is undoubtedly a sensation of fatigue which is related to dissatisfaction or psychoneurotic difficulties. Under these conditions people will say that they feel tired. There is, then, no single factor common to the sensations we call fatigue. What we need is a word to describe a characteristic of the organism as a whole—the sensation which appears when, for any reason, the organism is approaching breakdown.

The question remains whether any of the fatigues develop to such an extent that they are important in the work of a day, aside from a feeling at the end of the day that we need rest. At a certain point people are willing to go to bed and take rest at night. Consider specifically the problem in industry. The work done at Boulder Dam and Youngstown, which was reported to the Committee, showed that heavy work in the course of a spell of hot, dry weather produced fatigue of a very definite kind. There are conditions in various kinds of work which make it necessary for men to play or rest, and it would be misleading to imply that certain of the different states which are, in everyday language, called fatigue do not exist in industry. They do, but they are certainly much less common than is generally supposed. In the Relay Assembly Test Room and the Bank Wiring Observation Room of the Western Electric Company, there was certainly nothing that people would call fatigue unless it arose neurotically or from dissatisfaction. It may be well to point out that in these cases the sensation of fatigue is related to the total situation of the individual rather than to the specific operation he has to perform.

Professor Mayo, a member of the Committee, pointed out the

close relation between the extra-time allowances—for differences in skill and effort, for unavoidable delays, for personal needs, and for fatigue—and the human factor in industry. He naturally cited the experience of the Western Electric Company. In the Bank Wiring Observation Room there was no way of determining which delays were beyond the control of the operators, and the operators were reporting more unavoidable delays than in fact occurred. He cited also his experience in a textile mill in Philadelphia. The decision was taken to experiment with rest periods in a department of spinning mules, the mules to be shut down completely for the time of the rests. The mules worked at a standard speed and could not be speeded up. Nevertheless, in spite of the periods of shutdown, production was actually kept up, and in one month, when the workers were made to stop work for 40 minutes a day, in four periods, and lie down and rest, production was 10% greater during the month. Only one mule had a card showing the number of revolutions it had made. During this month, records were kept of the revolutions made by this mule, and the discovery was made that whereas, when the department had been operating on an all-day basis in the month before, this machine had been worked approximately 6½ hours out of the 10-hour day, now, when the 40 minutes of rest periods had been put in, the same mule worked about 7¾ hours out of the 10-hour day.

Again, in another industrial situation, an experiment was made in which six 5-minute rest periods were introduced in an 8-hour day. The personal time-out was reduced to a minimum. When the original conditions were restored, without rest periods, production was better, but personal time-out went back to its old figure.

Again, a foreman asked that rest periods be introduced in a particularly difficult operation. Investigations showed that the employees scouted at the idea. They said: "We do all our work in the morning and ease off in the afternoon." The men were operating machines which used current, and it was possible to test their statements by measuring the amount of current they were using. The current used in the morning was far more than in the afternoon, although apparently, even in the eyes of the foreman, they worked just as hard in the afternoon as ever.

The lesson of these cases is that fatigue, personal needs, even so-called unavoidable delays, cannot be isolated as separate factors in the time required to perform a task. Each one is in a state of mutual dependence with the others, and with further factors in the conditions of work. An increase in the amount of time allowed for fatigue will produce a decrease in the amount of time taken

for delays, and so on. In England, investigators in the field of industry were gradually forced to the conclusion that, while there was no fact left undescribed in the account they were giving of the way in which work was done, there was no factor which could definitely be termed fatigue and allowed for as such. If factors other than fatigue were sufficiently accounted for, there was no need to introduce the factor of fatigue. The Industrial Fatigue Board has now changed its name and is called the Industrial Health Board.

Professor Mayo pointed out, and Mr. Blair conceded, that even under the so-called stop-watch or time-study procedures, the personal judgment of the expert determined to a large extent the values given to the extra-time allowances. He suggested, in fact, that the belief of the expert that he is dealing with something based on scientific experiment may diminish his capacity for judgment. The problem, briefly put, is that of assigning values of some sort to the factors of differences in skill and effort, unavoidable delay, personal needs, and fatigue. If the work goes sufficiently well under the values assigned, the assumption is that they are accurate. He asked Mr. Blair how much correction had to be made in order to adapt the standards reached by time study to the actual work. Mr. Blair referred to the opinions of the men interviewed. "In the case of the largest establishment, they said that they have not corrected more than 10% of their standards. They employ between 10,000 and 15,000 persons. They installed their time-study plan in 1911 or 1912."

Dr. W. S. Hunter, a member of the Committee, asked Mr. Blair what, in general, was the attitude of labor toward management in the factories studied. Was labor in general satisfied? This question brought into the discussion Mr. H. J. Ruttenberg, a member of the Committee, and Research Director, Steel Workers Organizing Committee. Mr. Ruttenberg said: "I might say, in answer to Professor Hunter's question asking whether labor was satisfied with these time-study methods and the results, that I live in a district where the workers live, and spend almost all of my time with them, and they are emotionally dissatisfied, intellectually dissatisfied, and economically dissatisfied, essentially for the same reason that the Bank Wiremen (at the Hawthorne plant) pegged production, because of having to respond to technical changes which they did not originate, and in contrast to the Test Room girls, who increased production when they were consulted on technical changes."

Later, commenting on Mr. Blair's statement that in one establishment management had not corrected more than 10% of its output standards, Mr. Ruttenberg said: "When time studies are conducted

without the full and complete participation of the men who are being studied, and if we (that is, the Steel Workers Organizing Committee) find that there is a considerable amount of dissatisfaction, we go to the company and ask that studies be made in which the men do participate fully and completely, and we find that not less than 70% of the studies otherwise made are thrown out completely and new standards put in which are much higher in production. . . . One of the most fundamental impulses in a man in a shop is self-expression. If he is denied that in determining his wages, he feels much dissatisfied. If he is permitted expression in the production setup, then he feels that he has made a contribution to the whole."

Mr. Ruttenberg expanded his statement and cited experiences of his own. "This question of setting work standards is the most important one confronting us. Every steel company in Pittsburgh is under contract with our organization. With these companies we have fairly satisfactory relationships, but there is one problem that has been a source of irritation, and the union and the company are both attempting to solve it, and that is the problem arising out of these work standards.

"After becoming familiar with the Western Electric studies through this Committee, I felt confident to say to any company where the standards had been set exclusively by management without the men's participation that they were not getting anywhere near what they could out of the group. I was challenged by the president of one of the largest companies of Pittsburgh, and I said: 'You bring in your engineer, and let him tell me the spot where he thinks the most ideal situation prevails, with the greatest amount of production, and I will double it in a month.' They gave permission, and I went to the men, most of whom belonged to the union, and invited one shift out to my home, told them the whole situation, and asked what they could do on that job. One said, 'We have never really tried.' Another said he thought they could double the production. I told them to see if they could not do a little bit better, that it would have no effect on their rates and would not go against them. They went to 210% in a month. They did it in this way: they took an hour each day and saw what they could do in that hour for about 10 shifts, and then they decided to let it go for all eight hours.

"In another case, the men had a grievance as to the distribution of the 40 hours of the week. Most of them wanted five 8-hour days, but the company wanted the men to take half a day off Monday, Tuesday, Wednesday, Thursday, or Friday, and then come in on Saturday for 4 hours. The reason the company advanced was that orders came in at the last moment, and they wanted someone to take

care of them on Saturday. The men did not believe that. They worked out in detail how the company could be prepared for the emergency and take care of orders late on Friday. They brought their very convincing plan to me, and I took it to the president of the company. For about 15 minutes he was very quiet. After a while he said, 'I know that, and have known it for the last three or four years. We wanted the men to come in on Saturday because we send 10 men home on Monday for half a day, and 10 on Tuesday. . . . In sending them home we do not lose any production, and by bringing them in on Saturday, we get almost as much as we do on any other day.' So we told the men that if they could meet the production in five 8-hour days, they would not have to work on Saturdays, and they are doing that and better."

Much emphasis had been laid in the discussion on the importance of having the participation of the workers in setting output standards. Mr. Blair referred to this fact in his concluding remarks. He said that in the Pittsburgh district there are probably three companies in which the workers have some participation in the setting of output standards—three plants out of a total of approximately three hundred. One of the three companies has a closed shop; in the second, the workers who participate with the time-study engineer in setting the output standards are men who have received special training in that work. They are just as capable of being time-study men as the time-study men themselves.

In commenting on the discussion of his remarks, Mr. Blair made three important points. In the first place, he was only trying to describe what industry is doing in the matter of extra-time allowances; he was not justifying these practices. In the second place, he emphasized once more the factor of judgment in the rate setter, whether he is the foreman, the superintendent, or the time-study engineer. In the third place, he suggested that under some conditions the setting of extra-time allowances may not be a matter of great importance. For instance, it would not be of great importance to a highly skilled worker who took considerable responsibility in setting up his own job. But on another type of job, the extra-time allowances must be watched carefully, particularly where various pacing devices are used, such as power-driven conveyors. As soon as output standards are set for conveyors, each man must complete his job in the time prescribed. He is under pressure, and his work is so highly standardized both as to methods and as to tools that there is very little likelihood that he can use his own initiative. Under such conditions in the automobile industry, considerable fatigue developed, and we must look ahead to the time

when more and more power-driven equipment will be used. Mr. Blair had recently heard of a shirt factory in which shirts are being pressed on a conveyor-line basis.

In summary, the following seemed to be among the important understandings which emerged from Mr. Blair's remarks and the discussion which followed them:

Even under the stop-watch or time-study methods of determining output standards, the determination of the standard is only in part a matter of experiment and precise measurement, and is still to a large extent a matter of the judgment of a sufficiently trained observer.

The factors of differences in skill and effort, unavoidable delays, personal needs, and fatigue are in a state of mutual dependence with each other and with further factors. The assumption that they are independent entities for which specific allowance can be made in setting an output standard is often incorrect. An increase in the time allowed for one factor will often lead to decreases in the time taken for the others, and so forth.

If in practice work seems to go reasonably well under given output standards, the assumption is that they are accurate.

There is considerable dissatisfaction among workers about output standards and the methods of setting them. This dissatisfaction may be related to the fact that in general the workers do not participate in setting the standards.

Where for any reason workers do participate fully in setting output standards, experience shows that they are often able to produce more than was expected according to previous time studies.

The problem of output standards in general and of the extra-time allowances in particular will become more important the more commonly conveyor methods are used in industry. If certain procedures do not yield what is hoped, other procedures may have better results in the same field.

VIII. A Study of Organization

At the Conference on a Scientific Study of Industrial Labor Conditions, Mr. Chester I. Barnard, President of the New Jersey Bell Telephone Company, made a short address on the subject of "Corporate Management and Morals." Later, after the Committee had been organized, its meeting of February 28, 1939, included a discussion of Mr. Barnard's book, "The Functions of the Executive," then recently published. Mr. Barnard was present at the meeting as a guest. "The Functions of the Executive" is one of the few books on the nature of industrial (and other) organizations which have been written by a man who is himself an executive of an important organization. The Committee felt that a consideration of this book and of Mr. Barnard's views in general was a useful part of any study of research in industry.

In his address before the Conference, Mr. Barnard described how his study of organization grew out of his own experience. Until 1931, he had been an executive of the New Jersey Bell Telephone Company, but in that year he undertook an additional activity, the direction of the relief organization in his state. He found that he was forced to take a few steps which would have been heretical in the telephone organization, and he thought that it might be possible to take others.

What happened next can best be described in his own words: "One of the rules pretty generally followed in organizations of large size is not to 'jump' the line of organization in passing out orders or getting information. If you have an order from the top you give it through the line, and information from the bottom comes through the line. You avoid this sometimes skillfully and artistically, but as a rule it is necessary to follow the line. I thought in the particular instance of the relief organization that I was dealing with people who had not been inoculated with high organization practice. I suspected that the reactions we had to take into account in established organizations were artificial, and when I found it convenient to do so with the relief organization I went directly to the local man, and thus attempted to save trouble for everybody. Nevertheless, I found that what happened was exactly what would have happened in the telephone organization if I had done it there—

personalities, emotion, diffusion of responsibility, etc. This was a very great surprise to me. So I found something that seemed to be a matter of generalization—what you could not do in one type of organization you could not do in another."

Shortly afterward, Mr. Barnard read Professor Elton Mayo's book, "The Human Problems of an Industrial Civilization," which included a preliminary report of the Western Electric researches; and from these two experiences stemmed his effort to describe the characteristics which organizations have in common—organizations such as families, political parties, armies, churches, as well as industrial plants. His conclusions are stated in "The Functions of the Executive."

In Barnard's view, two misconceptions have obstructed the study of organization. One is the ancient theory of the nature of authority. The legal tradition has always, perhaps necessarily, considered that the state is the source of authority and that the other organizations of society exist by reason of the authority delegated to them by the state. Even within the political organization, the legal tradition has considered authority to be something emanating from a central position or organ, and ultimately, with compulsive power, reaching individuals. It has not thought of authority as arising out of the collaboration of the individuals themselves.

The second misconception is the doctrine of economic interest. Adam Smith and his followers created a theory of human behavior in which men were treated as if they were materialists, interested only in acquiring money or the things that money can buy, and as if they were rationalists, acting only as a result of a process of logical calculation. In practice people often disregarded economic doctrine. Nevertheless, it remained doctrine and to some extent blocked the creation of a more comprehensive theory of human behavior. In such organizations as churches, the presence of motives other than those usually considered in economics is obvious. Even in business organizations they are far more important than is usually recognized, and people who disregard them will make serious mistakes. From a criticism of these two misconceptions "The Functions of the Executive" takes its departure, with a warning that it seems "quite in order to cease encouraging the expectation that human behavior in society can be anything less than the most complex study to which our minds may be applied." [1]

The book falls into two parts. The first is a study of formal organizations, and the second is a study of the functions and methods

[1] Chester I. Barnard, "The Functions of the Executive," pp. xii-xiii. Cambridge, Harvard University Press, 1938.

of executives within these organizations. The two parts are necessarily dependent on each other. The first point which Barnard makes is that any process of co-operation involves physical, biological, and social components. To quote from his address at the Conference: "The most common phenomenon of social intercourse is oral speech, and if you will analyze it you will find that not a single sentence is made that is not a physical phenomenon, a physiological phenomenon, and a social phenomenon. Whatever is done has to be a composite of all those factors." Accordingly, Barnard sets up a definition, that of a *co-operative system:* "A co-operative system is a complex of physical, biological, personal, and social components which are in a specific systematic relationship by reason of the co-operation of two or more persons for at least one definite end." [1]

These components may be examined a little more closely. The physical environment—terrain, soils, minerals, and climate—obviously sets close limits on the development of some forms of organization, for instance, agricultural villages. Again, many organizations possess tools or plant of some sort: houses, churches, factories, railroads, ships. These things are among the physical components of co-operative systems. The most important biological components are of course those related to the properties of the human body. An obvious limitation of co-operative effort, though one usually disregarded, is the limited power and endurance of the human body. Most complicated are the social components. These may enter a co-operative system through being components of the individuals whose activities are included in the system: these individuals have received a certain social training. They may enter through their effect on individuals who are hostile to the system. They may enter through contact of the system with other, especially superior, systems, and finally they may enter as inherent in co-operation itself.

In the working conception of organization, these social components are taken for granted, are regarded as constants which may be neglected for most purposes. The single important exception is the relation of a co-operative system to the state, as this relation is defined in law, especially the law of incorporation. On the one hand, the lawyers think of organizations as unable to function without legal status. For them, "to organize" means the giving of such status. On the other hand, people who actually take part in organizations know that many of them, including many of the most important, function without any legal status at all, and that if they

[1] *Ibid.*, p. 65.

do incorporate they behave in much the same way after incorporation as before. Such people look on the state only as the vague and remote source of "authority" for what they do.

"The Functions of the Executive" begins by defining the expression *co-operative system.* It then proceeds to consider what we mean by *organization*—organizations are the particular object of its study. Obviously, an organization is a part, though only a part, of a co-operative system as defined. We do not think of the plant of a manufacturing company as being a part of its organization. On the other hand, we do think of an organization as a group of persons who are interacting with one another in definite ways. At the same time, we are sometimes at a loss to say where the boundaries of the group fall. In industry an organization is usually held to be made up of the officers of a company and the men in its employ. But in many circumstances the stockholders are an important part of the co-operating group, and in other circumstances the creditors, customers, and sources of supply must be included.

Barnard defines *formal organization* as "*a system of consciously co-ordinated activities or forces of two or more persons.*" [1] Note that this is a definition of formal organization. A number of important organizations, for instance, cliques, are considered informal organizations because the activities of their members are consciously co-ordinated to only a small degree. Nevertheless, it is likely that a large number of the characteristics of formal organizations are also the characteristics of informal ones. Note also that this definition speaks of activities and not of persons. The persons who are members of an organization are also members of many other organizations. Furthermore, during the period in which they are in theory co-operating in any given group, many of their interests, their thoughts, their activities are engaged elsewhere. What is important to organization is not the individual person but certain activities of that person.

This definition was designed to introduce some rigor into the discussion of organization, but once we have grasped the principle involved, we may speak a little more loosely. "When we are obliged in a practical sense to deal with intangible things chiefly characterized by relationships rather than by substance we have to symbolize them by concrete things, or personify them. In the case of organizations the only practicable device for everyday purposes under most circumstances is to symbolize a system called 'an organization' by the persons who are connected with it. For

[1] *Ibid.*, p. 73.

example, we think of an army as consisting of men; and in this case it would be so awkward as to be absurd not to do so." [1] Hence, although it defines organization as the co-ordinated *activities* of two or more persons, "The Functions of the Executive" in most circumstances follows customary practice by speaking of organizations as groups of persons and of persons as "members" of organizations.

"An organization comes into being when (1) there are persons able to communicate with each other (2) who are willing to contribute action (3) to accomplish a common purpose. The elements of an organization are therefore (1) communication; (2) willingness to serve; and (3) common purpose. These elements are necessary and sufficient conditions initially, and they are found in all such organizations. The third element, purpose, is implicit in the definition. Willingness to serve, and communication, and the interdependence of the three elements in general, and their mutual dependence in specific co-operative systems, are matters of experience and observation."[2] Barnard's views on organization can be discussed under these three heads, provided we remember that communication, willingness to serve, and common purpose are in fact interdependent elements and reference to any one will involve cross references to the others.

Characteristic of any organization is a system of communication. This system consists of a periphery or, to speak in terms of the human body, of a number of nerve endings at which the organization is in immediate contact with the environment on which it is operating. The environment is of course defined by the purposes of the organization. In the case of a village, the environment is the physical world. In the case of an army, the environment, or an important part of the environment, is the opposing army. In the case of a church, the environment consists of individuals and other organizations. The persons who occupy the peripheral positions make up the largest single group in most organizations. They are often called the rank and file. From the peripheral positions, communications pass to a series of communication centers, now usually called executives, and from the executives further communications pass back to the periphery. To use the current jargon, reports and communications pass up, orders and decision down, the "line." Many of the communications take the form of spoken or written words. "The Functions of the Executive" emphasizes also "observational feeling": "A very large element in special experience and training and in continuity of individual association is the ability

[1] *Ibid.*, pp. 74-75.
[2] *Ibid.*, p. 82.

to understand without words, not merely the situation or conditions, but the *intention*." [1] In many organizations the communication system is described with the help of a diagram, often in the form of a pyramid. Perhaps because it can be diagrammed the communication system often receives excessive explicit attention.

Simply as a matter of historical fact, most large organizations begin as very small ones. Examples are the Twelve Apostles and the small group of persons who formed the original Nazi party. And organizations grow by adding new small groups to the original one. Yet most persons do not think of the development of organization as occurring in this way. "The origins of the major organizations being historically so remote, and the processes of reorganization being apparently often directed from central points or by central authority, we are much under the delusion that large mass organizations are subdivided as a secondary process, the mass having first been created. . . . But this procedure is as if we subdivided a trunk of a tree or a piece of flesh into fibres and membranes and finally into cells, being misled into thinking that these subdivisions developed after the existence of an undifferentiated protoplasm of the same mass." [2]

All large organizations, then, are made up of numbers of small organizations, which Barnard calls unit organizations. He turns to a study of these units. In the first place, they are inherently limited in size through the difficulties of effective leadership. It is true that an orchestra conductor can direct a hundred men or more, but communication in this case is limited to one direction. In most cases the unit must be much smaller. An army squad is perhaps near the average in size.

The unit organizations are combined to form larger organizations, the leaders of the units becoming the communication centers of the first order in the larger organizations. But here it is well to quote directly from "The Functions of the Executive": "In a unit organization there are executive functions to be performed, but not necessarily by a single individual continuously. They may be performed alternately by the several persons who contribute to the organization. In complex organizations, on the other hand, the necessities of communication result almost invariably in the localization of the executive functions of the subordinate unit organizations normally in one person. This is necessary for reasons of formal communications; but it is also necessary to establish executive organizations, that is, those units specializing in the executive functions.

[1] *Ibid.*, p. 90.
[2] *Ibid.*, p. 105 n.

The executives of several unit organizations as a group, usually with at least one other person as a superior, form an executive organization." [1] According to this analysis, the persons who exercise executive functions are members of two unit organizations: the so-called "working" unit and the executive unit. From one point of view a corporal is a member of his squad and from another is a member of the "regimental organization." "Under such condition a single concrete action or decision is an activity of two different unit organizations. This simultaneous contribution to two organizations by a single act appears to be the critical fact in all complex organizations; that is, the complex is made an organic whole by it." [2]

The small size of the unit organization is repeated in the executive organization. In ordinary language, an executive has a relatively small number of subordinates who report to him directly. Under many circumstances an executive is most effective when he has not more than five or six men reporting to him.

The next aspect of organization to be considered is informal organization. Whether or not they have conscious co-operative purposes, people are always associating with one another, coming into contact with one another, interacting. Furthermore, this interaction may be more frequent between certain persons than between these persons and others whom they consider outsiders, and as a result cliques, classes, communities, and nations appear. Through this interaction sentiments develop and are transmitted from person to person. On a large scale it results in what are called "states of mind," "public opinion," "national characteristics."

Informal organization is the name given to this interaction between persons which has no specific, conscious, joint purpose. But there is no line that can clearly be drawn between informal and formal organization. The Western Electric researches showed that the informal association of men in groups could result in the appearance of leaders and the adoption of common purpose—both characteristic of formal organization.

Informal organization precedes formal organization and must do so. "Informal association is rather obviously a condition which necessarily precedes formal organization. The possibility of accepting a common purpose, of communicating, and of attaining a state of mind under which there is willingness to co-operate, requires prior contact and preliminary interaction. This is especially clear in those cases where the origin of formal organization is spontaneous. The informal relationship in such cases may be exceedingly brief,

[1] *Ibid.*, p. 111.
[2] *Ibid.*, pp. 111-112.

and of course conditioned by previous experience and knowledge of both informal and formal organization."[1]

Purely passive association among men is not long-lasting. They feel a need for activity, and this activity is social. They feel impelled to do something, and as a result develop common purposes, even if the purposes are little more than matters of form, and what is important is the social intercourse incidental to the accomplishment of the purposes. In short, formal organizations naturally arise out of the informal association of men. Once formed, they provide established patterns of activity, and it is of the greatest importance that these patterns should exist. "Where circumstances develop so that a variety of outlets for activity involving associations are not readily available—as is often the case, for example, with unemployed persons—the situation is one in which the individual is placed in a sort of social vacuum, producing a feeling and also objective behavior of being 'lost.'. . . Where the situation affects a number of persons simultaneously they are likely to do any sort of mad thing."[2]

Furthermore, any society seems to require a number of formal organizations, large and small. If the formal organizations do not exist, people split up into a number of hostile groups, the hostility against outsiders becoming the chief factor of internal cohesion in each of the groups. On the other hand, if there is an expansion of one type of formal organization, there must necessarily be an expansion of others. "This is most obviously the case when formal organization complexes of government expand—government itself is insufficient, except where economic and religious functions are included in it. Where with the expansion of formal government complexes there is correlative expansion of religious, military, economic, and other formal organizations, the structure of a large-scale society is present."[3]

Barnard has been looking at one aspect of the relationship between formal and informal organization. He now turns to the other: formal organizations create informal organizations and must do so. This fact was made abundantly clear in the Western Electric researches, where investigation revealed informal organizations either collaborating effectively in management policies or acting so as to nullify them. It has often been said that " 'you can't understand an organization or how it works from its organization chart, its charter, rules and regulations, nor from looking at or even watching its personnel.' 'Learning the organization ropes' in most organiza-

[1] *Ibid.*, pp. 116-117.
[2] *Ibid.*, p. 118.
[3] *Ibid.*, p. 120.

tions is chiefly learning who's who, what's what, why's why, of its informal society." [1] Yet many executives of experience will deny the existence of such informal organization in their own formal organizations, perhaps for the very reason that it is informal.

One of the important functions of informal organization is increasing the willingness to serve in formal organization. The Western Electric researches showed how great the satisfactions are which men get out of association with other men in an informal social group. Unless an organization provides such satisfactions, men will be unwilling to take part in it. Formal organization tends to treat men as cogs in a machine. At least they feel that it does. They are dominated by an impersonal objective and by impersonal authority. Informal organization, on the other hand, is felt to be a matter of free choice which gives a man a chance to express his own attitudes rather than organization ones. "Though often this function is deemed destructive of formal organization, it is to be regarded as a means of maintaining the personality of the individual against certain effects of formal organizations which tend to disintegrate the personality." [2]

Another function of informal organization is communication. Some of the most important understandings in an organization are not transmitted through the formal lines of communication but through informal contacts. Many formal orders could not be properly interpreted without much previous informal communication. Others are in fact corrected by the action of informal organization. Such informal communication is especially vital among members of the executive group, and Barnard spends some time discussing what he calls "informal executive organization." A prerequisite of the development of informal organization is the personal compatibility of the persons concerned. Accordingly, many organizations, in fact, if not as a matter of explicit attention, see to it that in such respects as sex, age, race, nationality, politics, and in manners, speech, and personal appearance its executives are persons who can associate freely with one another. "The functions of informal executive organizations are the communication of intangible facts, opinions, suggestions, suspicions, that cannot pass through formal channels without raising issues calling for decisions, without dissipating dignity and objective authority, and without overloading executive positions; also to minimize excessive cliques of political types arising from too great divergence of interests and views; to promote self-discipline of the group; and to make possible the

[1] *Ibid.*, p. 121.
[2] *Ibid.*, p. 122.

development of important personal influences in the organization. There are probably other functions." [1]

One of the most important chapters of "The Functions of the Executive" is that entitled "The Theory of Authority." This chapter in particular was discussed at the meeting of the Committee on February 28, 1939, and therefore it is proper to devote some space to it here. It deals with the operation of the system of communication in an organization.

The first point to be made is that the authoritative communications of organizations are very often disregarded. In other words, orders are disobeyed. Behavior of this kind is familiar to Americans in the disrespect for law, but something of the same sort occurs in all organizations. Rules are treated as dead letters and disobedience is elaborately overlooked. This observation does not imply that men are naturally lawless and heedless of authority. It means only that the acceptance of authority is always a matter of individual decision under particular circumstances. We refer to this fact when we say that "government rests upon the consent of the governed"—a statement which is as much true of a dictatorship as of a democracy.

Accordingly Barnard defines *authority* as "the character of a communication (order) in a formal organization by virtue of which it is accepted by a contributor to or 'member' of the organization as governing the action he contributes; that is, as governing or determining what he does or is not to do so far as the organization is concerned." [2] "Therefore, under this definition the decision as to whether an order has authority or not lies with the persons to whom it is addressed, and does not reside in 'persons of authority' or those who issue these orders." [3]

Authority has two aspects: the subjective, the process by which the individual accepts a communication as authoritative; and the objective, the character of the communication by virtue of which it is accepted. They may be considered in this order. "A person can and will accept a communication as authoritative only when four conditions simultaneously obtain: (*a*) he can and does understand the communication; (*b*) *at the time of his decision* he believes that it is not inconsistent with the purpose of the organization; (*c*) *at the time of his decision,* he believes it to be compatible with his personal interest as a whole; and (*d*) he is able mentally and physically to comply with it." [4] These conditions explain them-

[1] *Ibid.*, p. 225.
[2] *Ibid.*, p. 163.
[3] *Ibid.*, p. 163.
[4] *Ibid.*, p. 165.

selves, with the possible exception of the second, and there will be a further discussion of this point later. Barnard cites the case of an employee of a water system ordered to blow up an essential pump, or soldiers ordered to shoot their own comrades. Under these circumstances, the individual who received the order would certainly feel that it was inconsistent with the purpose of the organization, would refuse to obey, and authority would go to pieces.

The question which is raised next is an obvious one. How is it possible to secure such manifold and enduring co-operation as in fact exists if the determination of authority lies with the subordinate individual? Barnard's answer is the following: "It is possible because the decisions of individuals occur under the following conditions: (a) orders that are deliberately issued in enduring organizations usually comply with the four conditions mentioned above; (*b*) there exists a 'zone of indifference' in each individual within which orders are acceptable without conscious questioning of their authority; (*c*) the interests of the persons who contribute to an organization as a group result in the exercise of an influence on the subject, or on the attitude of the individual, that maintains a certain stability of this zone of indifference." [1]

Brief comment on these three conditions is necessary. As for the first, there is no principle of executive conduct better established than that orders will not be issued which cannot or will not be obeyed. Such orders destroy authority, discipline, and morale. As for the second, most orders which an individual receives in an organization do not run counter to any definite personal interest and lie within the range of orders which he anticipated when he joined the organization. As for the third, the person who denies authority destroys organization itself, and therefore his action is felt as a threat to all other organization members, provided the authority is not unacceptable to them also. Accordingly, in most organizations at most times the members have a personal interest in seeing that orders are obeyed which are for them within the zone of indifference. This interest is expressed through informal organization and is spoken of as "public opinion," "organization opinion," "feeling in the ranks," "group attitude," etc.

Another question is raised at this point. If the determination of authority in an organization lies with the individual member who decides to obey an order, especially as he is influenced by other individuals who have similar decisions to make, why do we regu-

[1] *Ibid.*, p. 167.

larly assert that authority rests in superior offices or boards? Why do we create the fiction of superior authority? The statement which "The Functions of the Executive" makes on this point is particularly important and must be quoted at length. It is as follows:

"The fiction of superior authority is necessary for two main reasons:

"(1) It is the process by which the individual delegates upward, or to the organization, responsibility for what is an organization decision—an action which is depersonalized by the fact of its co-ordinate character. This means that if an instruction is disregarded, an executive's risk of being wrong must be accepted, a risk that the individual cannot and usually will not take unless in fact his position is at least as good as that of another with respect to correct appraisal of the relevant situation. Most persons are disposed to grant authority because they dislike the personal responsibility which they otherwise accept, especially when they are not in a good position to accept it. The practical difficulties in the operation of organization seldom lie in the excessive desire of individuals to assume responsibility for the organization action of themselves or others, but rather lie in the reluctance to take responsibility for their own actions in organization.

"(2) The fiction gives impersonal notice that what is at stake is the good of the organization. If objective authority is flouted for arbitrary or merely temperamental reasons, if, in other words, there is a deliberate attempt to twist an organization requirement to personal advantage, rather than properly to safeguard a substantial personal interest, then there is a deliberate attack on the organization itself. To remain outside an organization is not necessarily to be more than not friendly or not interested. To fail in an obligation intentionally is an act of hostility. This no organization can permit; and it must respond with punitive action if it can, even to the point of incarcerating or executing the culprit. This is rather generally the case where a person has agreed in advance in general what he will do. Leaving an organization in the lurch is not often tolerable." [1]

Barnard points out that the "fiction of superior authority" is a fiction in the sense that it does not indicate the basis of authority. Nevertheless, he continues: "Either as a superior officer or as a subordinate . . . I know nothing that I actually regard as more 'real' than 'authority'." [2]

[1] *Ibid.*, pp. 170-171.
[2] *Ibid.*, p. 170 n.

So far the discussion has been concerned with the subjective aspect of authority. It now turns to the objective aspect: the character of a communication by virtue of which it is obeyed. In order to secure objective authority, the communication system of an organization must conform to certain conditions. These are as follows:

1. *The channels of communication should be definitely known.* Accordingly, official appointments are made known, organization charts are drawn, individuals are assigned to definite positions. More important than anything else is simple practice. Drill is obviously of the greatest importance in military organizations, but something of the same sort must occur in all organizations. The channels of communication are known because they are actually used.

2. *Objective authority requires a definite formal channel of communication to every member of an organization.* This statement simply means that a formal organization has a formal relationship with each of its members. In ordinary language it means that "everyone must report to someone" (communication in one direction) and "everyone must be subordinate to someone" (communication in the other direction).

3. *The line of communication must be as direct or short as possible.* The passage of orders and reports through the communication system takes time. Furthermore, as orders move outward in the system, they must be made more and more detailed; as reports move inward, they must be made more and more general. Something may be lost in the process. For these reasons, the line of communication should be short, and as a matter of fact in even the largest organizations, such as an army or the Roman Catholic Church, the levels of communication are seldom more than ten. Various devices are used to keep the lines of communication short. "Briefly, these methods are: The use of expanded executive organizations at each stage; the use of the staff department (technical, expert, advisory); the division of executive work into functional bureaus; and processes of delegating responsibility with automatic co-ordination through regular conference procedures, committees for special temporary functions, etc." [1]

4. *The complete line of communication should usually be used.* If it is not, conflicting communications may be issued, general orders may not receive their proper detailed interpretation, the responsibility and prestige of officers may be impaired. The rule

[1] *Ibid.*, p. 177.

against "jumping the line" is one of the important general rules of organization.

5. *The competence of the persons serving as communication centers, that is, officers, supervisory heads, must be adequate.* The competence required of course varies both in degree and in kind according to the office in question, becoming more and more general the closer the office is to the center of the communication system. As a matter of fact, we do not nowadays expect people to have personal ability adequate to the requirements of an important office in a large organization. The amount of time, energy, and technical knowledge required is too great. Therefore the communication centers are themselves organized, and staff departments advise the person who actually holds the position of responsibility on all matters concerning his decisions. Barnard also points out that there are very few important organizations—they include some churches and some absolute governments—"in which the highest objective authority is not lodged in an *organized* executive group, that is, a 'highest' unit of organization." [1]

6. *The line of communication should not be interrupted during the time when the organization is to function.* Accordingly, in many organizations emphasis is put on the "office" being more important than the "man," and pains are taken to see that positions are automatically filled when the individuals who usually occupy them are unable to do so. The necessity for such formal substitution is "not merely that specific communications cannot otherwise be attended to. It is at least equally true that the *informal* organization disintegrates very quickly if the formal 'line of authority' is broken. In organization parlance, 'politics' runs riot. Thus, if an office were vacant, but the fact were not known, an organization might function for a considerable time without serious disturbance, except in emergency. But if known, it would quickly become disorganized." [2]

7. *Every communication should be authenticated.* The position of any person who issues an order should be known, and the field to which the order refers should be known to be within his competence. For this reason, and in order to dignify superior position, which is "an important method of dignifying *all* connection with organization," [3] officers are solemnly inducted into their posts. In some organizations, they wear distinctive dress, etc. Furthermore, an order itself must bear on its face the evidence that it is actually

[1] *Ibid.*, p. 179.
[2] *Ibid.*, p. 180.
[3] *Ibid.*, p. 181.

an authorized communication from the proper office. Accordingly, official forms are given to orders.

"The Functions of the Executive" makes a subsidiary distinction between two kinds of authority. One is the authority of position. The orders of certain persons in an organization are accorded authority simply because these persons occupy superior positions in the communication system. This authority is to a certain extent independent of the men who occupy the positions. The other kind of authority is that of leadership. Certain persons are recognized as having superior ability, and for that reason alone people impute authority to what they say. When able leaders are also in superior positions, men will willingly obey their orders even under trying conditions.

Experience shows that objective authority is easily destroyed. It is maintained only if the positions of authority continue to be adequately informed. The Western Electric researches showed that the management of the Hawthorne plant issued orders which were not obeyed and that it did so because it was not adequately informed of the actual situation at the work level. "In very rare cases persons possessing great knowledge, insight, or skill have . . . adequate information without occupying executive position. What they say ought to be done or ought not to be done will be accepted. But this is usually personal advice at the risk of the taker. Such persons have influence rather than authority." [1] As a matter of fact such persons are usually forced to accept positions of responsibility, since only in this way can their competence to speak about the concrete problems of the organization be made known.

Finally, objective authority is destroyed if leadership fails "(chiefly by its concrete action) to recognize implicitly its dependence upon the essential character of the relationship of the individual to the organization." [2] Government must show that it appreciates that it depends on the consent of the governed.

Barnard sums up in a paragraph his position on the subject of authority: "It may be said, then, that the maintenance of objective authority adequate to support the fiction of superior authority and able to make the zone of indifference an actuality depends upon the operation of the system of communication in the organization. The function of this system is to supply adequate information to the positions of authority and adequate facilities for the issuance of orders. To do so requires commensurate capacities in those able

[1] *Ibid.*, p. 174.
[2] *Ibid.*, p. 174.

to be leaders. High positions that are not so supported have weak authority, as do strong men in minor positions.

"Thus authority depends upon a co-operative personal attitude of individuals on the one hand; and the system of communication in the organization on the other. Without the latter, the former cannot be maintained." [1]

The present summary of "The Functions of the Executive" may turn next to the second of the three elements of organization, namely, willingness to co-operate. This element has already been considered implicitly; it can now be given explicit attention. The only objective standard we have of the success of an organization is its ability to survive, and Barnard points out that organizations are inherently short-lived. In western civilization, only one organization, the Roman Catholic Church, has any great age, and only a few others, national governments, universities, municipalities are more than a hundred years old. The failure of co-operation is the rule rather than the exception. In a modern society the preponderance of persons is unwilling to take part in any particular existing or potential organization. Therefore in any organization, great attention must be paid to the work of inducing people to contribute their services.

"The Functions of the Executive" discusses the survival of organizations in terms of *effectiveness* and *efficiency*. In order to survive, an organization must be effective or efficient, or both. To be effective it must accomplish the recognized objectives of co-operative action. True, the action taken by an organization and the results secured may be sufficient to satisfy the individual contributors even if the ostensible end of co-operation is not attained. Nevertheless, "the attainment of some end, and belief in the likelihood of attaining it, appears necessary to the continuance of co-ordinated action. Thus, even though the attainment of a given end is not necessary for itself, it is necessary to keep alive the co-operation. Effectiveness from this point of view is the minimum effectiveness that can be tolerated. Hence it can be seen that the attempt to do what cannot be done must result in the destruction or failure of co-operation." [2]

Whereas effectiveness relates to the action of the organization as a whole, efficiency relates to the satisfaction of the individuals concerned. An individual does not continue to contribute his activity to an organization unless the satisfactions he gets from doing so are greater than those he would get from not doing so. This point

[1] *Ibid.*, pp. 174-175.
[2] *Ibid.*, p. 56.

is obvious, but often forgotten, and it holds good whatever the motives of the individual may be. "Thus, the efficiency of a co-operative system is its capacity to maintain itself by the individual satisfactions it affords." [1]

Therefore, "the individual is always the basic strategic factor in organization. Regardless of his history or his obligations he must be induced to co-operate, or there can be no co-operation." [2] In order to induce him to do so, an organization can take two steps. It can offer objective inducements, either positive or negative. That is, it can increase the advantages or decrease the burdens of co-operation. Or it can change the states of mind of individuals. The first is called the "method of incentives"; the second, the "method of persuasion." An organization may appear to adopt one of these methods in preference to the other. Thus an industrial organization appears to adopt the method of incentives; a religious organization, the method of persuasion. As a matter of fact most organizations must use both methods, though in different proportions. An industrial organization must inculcate "loyalty" in its members. A church must pay its priests.

Turning to the method of incentives, Barnard divides the incentives which can be offered by an organization into two classes: "first those that are specific and can be specifically offered to an individual; and second, those that are general, not personal, that cannot be specifically offered." [3] "The Functions of the Executive" then proceeds to discuss the incentives in detail beginning with the first class.

1. *Material inducements*, that is, money or the things that money can buy. This incentive appears to be powerful in our society and certainly is always described as being powerful. At the subsistence level it is powerful in fact, and any organization that occupies a large part of the time of its members must supply them with money or goods. Beyond the subsistence level, the theory that this incentive is decisive is largely an illusion. If organizations could make sure of getting able executives simply by offering high salaries, it would obviously be worth their while to offer far higher salaries than they do today. But all the evidence shows that they cannot. Barnard offers an explanation for the overemphasis placed on material inducements: "The emphasis upon material rewards has been a natural result of the success of technological developments—relative to other incentives it is the material things which have been pro-

[1] *Ibid.*, p. 57.
[2] *Ibid.*, p. 139.
[3] *Ibid.*, p. 142.

gressively easier to produce, and therefore to offer. Hence there has been a forced cultivation of the love of material things among those above the level of subsistence. Since existing incentives seem always inadequate to the degree of co-operation and of social integration theoretically possible and ideally desirable, the success of the sciences and the arts of material production would have been partly ineffective, and in turn would have been partly impossible, without inculcating the desire of the material." [1] In short, western civilization might not have developed in the way it has, if many of its members, as a result of advertising, economic theorizing, and other more subtle means, had not been persuaded that material benefits of all sorts were desirable. Yet in spite of all persuasion, this incentive remains relatively weak. The success and survival of many organizations, including some of the oldest, which have not been able to offer material benefits in large amounts, are sufficient proof of this statement.

2. *Personal, non-material opportunities.* These are of great importance in all organizations, and include the opportunities for gaining distinction, prestige, and personal power. Even commercial organizations cannot get persons to contribute their services by paying them high salaries, if these salaries are not accompanied by equivalent marks of prestige. In fact, a salary is not so important for the economic power as for the degree of distinction it confers. The personal power enjoyed by the executive of a large organization is largely an illusion, since his activity is more limited by the requirements of the organization than that of any other member. Nevertheless the illusion is "a very dear one to some."

3. *Desirable physical conditions of work.* Nothing in detail need be said about this incentive. Many organizations pay great attention to it.

4. *Ideal benefactions.* These incentives are among the most powerful and among the most often neglected. "They include pride of workmanship, sense of adequacy, altruistic service for family or others, loyalty to organization in patriotism, etc., aesthetic and religious feeling. They also include the opportunities for the satisfaction of the motives of hate and revenge, often the controlling factor in adherence to and intensity of effort in some organizations." [2]

The foregoing incentives are specific and can be offered to particular individuals. There are others which are created by some

[1] *Ibid.*, p. 143.
[2] *Ibid.*, p. 146.

organizations but cannot be specifically offered. These are the general incentives and are classed as follows:

5. *Associational attractiveness.* If men are to work together successfully, they must be compatible. "For when there is incompatibility or even merely lack of compatibility, both formal communication and especially communication through informal organization become difficult and sometimes impossible." [1] Race, class, or national hostilities often prevent all co-operation, but incompatibilities of other and less specific kinds are often more important than is generally recognized in limiting co-operation, though intimate knowledge of the organizations concerned is usually necessary for understanding why they are so. In the rules they adopt for the admission of members, many organizations see to it that all those who co-operate shall be compatible.

6. *Adaptation of conditions to habitual methods and attitudes.* In organizations of all kinds, recruits with "foreign" methods and attitudes will not be accepted. Men want to work in the way they have been used to working.

7. *The opportunity of enlarged participation.* Men feel that the purposes of some organizations are particularly weighty and that in joining these organizations they will be taking a larger part in affairs. For this reason, men would rather join large organizations than those they consider small or ineffective. For this reason also, among others, organizations tend to grow in size.

8. *The condition of communion.* This incentive is among the most intangible and subtle, but also among the most powerful. When the condition of communion exists, men feel that they are members of a body of kinsmen who will stand together in all trials and rejoice together in all successes. Only when this condition exists does a man feel real social security, as contrasted with the economic security which now passes for such. As an example of the condition of communion, the fact may be cited that in the behavior of an army comradeship is more important than patriotism.

So far consideration has been given to the method of incentives. "The Functions of the Executive" next turns to the method of persuasion, which includes (a) the creation of coercive conditions; (b) the rationalization of opportunity; (c) the inculcation of motives.

At least in the form of exclusion of members, a certain amount of coercion is used in all organizations. In many organizations of the past and, of course, some of the present, coercion by physical

[1] *Ibid.*, p. 147.

force has been commonly employed. But, generally speaking, it is recognized that no superior form of organization can be maintained to any large extent by coercion alone.

A more important form of persuasion is the rationalization of opportunity, that is, the process of convincing people that they ought, that it is to their interest, to take part in the work of an organization. In the modern states in which coercion is most commonly used, this method of persuasion is also an important formal concern of government. We call it propaganda. As a matter of fact, something which is to all intents and purposes the same as propaganda must be spread informally in all states. Other forms of the rationalization of opportunity will occur to anyone. The rationalization of materialistic progress has already been mentioned. People in western civilization have been persuaded by many methods, of which advertising is the most obvious but not necessarily the most powerful, that it is worth while to acquire material goods of all kinds. As a result many persons have been kept alive and employed who would not otherwise have been. Yet in spite of all efforts, the desire for material gain remains relatively weak compared to some of the other incentives.

The most important form of persuasion is the inculcation of motives, but it is usually out of the direct control of formal organizations. Broadly speaking, it involves what we call education, and its decisive steps are taken at an early age. Education is largely in the hands of families, schools, and the informal organizations of society; but on the attitudes, emotions, and habits thus engendered the possibility of co-operation in formal organization depends.

An organization must be in a position to bring most of these incentives to bear on its members and potential members, though the proportions possible and necessary vary with the type and purpose of organization. Furthermore an organization must command a surplus of incentives. If the advantages of membership in an organization just balance the disadvantages, people will be indifferent to joining. In the case of material incentives, this principle is well understood and is discussed in economic theory, but the same method of thinking must be applied to incentives of all kinds. "It is also true, of course, that the scheme of incentives is probably the most unstable of the elements of the co-operative system, since invariably external conditions affect the possibilities of material incentives; and human motives are likewise highly variable. Thus incentives represent the final residual of all the conflicting forces involved in organization, a very slight change in underlying forces often making a great change in the power of incentives; and yet it is only by the

incentives that the effective balancing of these forces is to be secured, if it can be secured at all." [1]

The third element of organization is purpose, and this is the unifying principle of the whole. The point has already been made that purely passive or bovine association among men is rare and unstable. When they associate together, they associate to do something; that is, they develop a common purpose. Every organization in fact has a purpose or purposes. In many formal organizations these purposes are consciously formulated. In many others they are not formulated but must be inferred from the action the organization takes. Purpose of some sort there always is.

Purpose always implies an environment, either physical or social, which is to be acted upon. In fact purpose gives meaning to the environment. We must look at the world that surrounds us from some point of view, and one common practice is to look at it from the point of view of what can be done with it. Furthermore, co-operation implies specialization. At the upper levels of organization, decisions relating to the general ends to be pursued require the major attention. At the intermediate level, these ends are broken down into more and more concrete purposes, until finally they relate to technologically correct conduct. Barnard points out that the largest number of decisions in any organization are taken at the lowest level, where the organization is in touch with whatever constitutes its environment. Individual skill and technical ability can have no other meaning.

Since purpose is the unifying principle of organization, the concrete purposes must be understood and accepted at every level, including the lowest, or organization disintegrates. This statement does not mean that each unit organization must understand the purpose of the whole of which it is a part. Often such understanding will help in the accomplishment of detailed purpose; but often it will not and often it cannot be given. "Thus it is not essential and usually impossible that the company should know the specific objectives of the army as a whole; but it is essential that it know and accept *an* objective of its own, or it cannot function. If it feels that the whole depends upon the achievement of this objective, which it is more likely to do if it understands what the whole objective is, the intensity of its action will ordinarily be increased. It is belief in the cause rather than intellectual understanding of the objective which is of chief importance. 'Understanding' by itself is rather a paralyzing and divisive element." [2]

[1] *Ibid.*, pp. 158-159.
[2] *Ibid.*, pp. 137-138.

Here an important distinction is made between the objective purpose of organization, for instance, the purpose as it would be viewed by a detached observer, and the co-operative purpose, that is, the purpose as it appears to the individual members of the organization. Sometimes there is a divergence between the two. Where the purpose of co-operation is the accomplishment of some simple physical result, the divergence is usually not great. The members take much the same view of the purpose of their co-operation, and this view is not far different from the objective purpose. But when the purpose is less tangible—for example, in religious co-operation—the divergence may be great; and if this fact is recognized, disruption of the organization may follow. The recognition of the divergence is the decisive event.

"We may say, then, that a purpose can serve as an element of a co-operative system only so long as the participants do not recognize that there are serious divergences of their understanding of that purpose as the object of co-operation. If in fact there is important difference between the aspects of the purpose as objectively and as co-operatively viewed, the divergencies become quickly evident when the purpose is concrete, tangible, physical; but when the purpose is general, intangible, and of sentimental character, the divergencies can be very wide yet not be recognized. Hence an objective purpose that can serve as the basis for a co-operative system is one that is *believed* by the contributors (or potential contributors) to it to be the determined purpose of the organization. The inculcation of belief in the real existence of a common purpose is an essential executive function. It explains much educational and so-called morale work in political, industrial, and religious organizations that is so often otherwise inexplicable." [1]

At the end of his book, Barnard takes up the work of executives in organizations. The members of every organization may be divided into two main classes: those who are in immediate contact with the environment, physical and social, upon which the organization is operating, and those who are not. The latter are placed at the centers of communication of the organization and are called executives. So placed, the executives, like all other members of the organization, have specialized functions.

Executive work has three aspects, corresponding to the three elements of organization. The first aspect is that of the communication system. The executives are at the centers of the communication system, and their work is concerned with devising the system,

[1] *Ibid.*, p. 87.

changing it to further the purposes of organization, and selecting the personnel to take the different positions. The problem is one of men and positions, and the two are mutually dependent. "Executives, when functioning strictly as executives, are unable to appraise men in the abstract, in an organization vacuum, as it were. Men are neither good nor bad, but only good or bad in this or that position. This is why they not infrequently 'change the organization,' the arrangement of positions, if men suitable to fill them are not available." [1] A large part of the work of the higher executives, though they may not think of it in these terms, is facilitating and maintaining informal executive organization. The importance of such organization has already been pointed out.

The second aspect of executive work is that of willingness to co-operate. Executives must always be concerned with securing essential services from individuals, first in recruiting new members, an important part of the activity of all organizations, particularly religious and political ones; secondly, in maintaining the supply and the balance of inducements and incentives necessary to keep individuals co-operative once they have been recruited. The third aspect of executive work is that of purpose. Executives formulate the general purposes of organization and break them down into constituent detailed purposes which approach concrete acts more and more closely. Furthermore, the higher executives must continually indoctrinate their subordinates with the general purposes of organization so that the ultimate detailed decisions shall be coherent. Finally, in all but unit organizations, no single executive can do all the executive work. It must be divided among positions and the province of each position defined. Therefore an important part of executive work is the assignment of objective authority.

In short, "executive work is not that *of* the organization, but the specialized work of *maintaining* the organization in operation." [2] If the president of a manufacturing concern goes out personally to sell the products of his concern, his work is not executive work, though he is an executive. At this point the present summary of "The Functions of the Executive" may properly be brought to a close.

Many people who read "The Functions of the Executive" for the first time are bewildered by it. Partly because of its title and the position of its author, they expect to find a detailed account of the job of executive in a large modern organization, and they find

[1] *Ibid.*, p. 218.
[2] *Ibid.*, p. 215.

something far different from that—something more important. The book is in fact an attempt to set forth the field of human organization as an object of formal study, just as earlier scientists have set forth such objects as the physicochemical system and the economic system. It is also an attempt to state systematically the elements of this relatively new field. As such, it necessarily attempts to make explicit many things which are ordinarily taken for granted, and it deals in generalizations of a high order. These are the intentions of the book, and on these it should be judged.

IX. Summary

This report may well be ended by a series of brief statements summarizing a few of the important conclusions reached in the course of the investigations which have been studied. These statements are the following:

1. The efficiency of workers in industry is drastically affected by certain physical conditions of work; for instance, extreme heat and high altitude.

2. Some of the effects of these conditions on the worker may be considered physiological and the psychological results neglected for practical purposes. Such is the case in heat cramps. Sometimes, under these circumstances, practical applications of research can rather easily be made: heat cramps can be prevented or cured by the administration of salt.

3. Under other conditions, such as oxygen lack at high altitudes, disturbances in the physiological equilibrium at once entail disturbances in the psychological equilibrium. In piloting an airplane, the interaction of these two classes of factors in the behavior of the organism as a whole is of the first importance.

4. The converse is also true. Disturbances in the psychological equilibrium may entail disturbances in the physiological equilibrium. Some people, under conditions of mental stress, develop feelings of fatigue, aches and pains, etc. Dr. Robinson showed how these conditions may arise in industry. In short, the origin of unbalance differs, and we may call the unbalance physiological or psychological, but unbalance tends to involve the whole organism. It is, indeed, a name for a state of the whole organism.

5. The efficiency of workers is affected by certain physical conditions, but these conditions are not very often encountered in ordinary work in industry. The Western Electric researches, particularly the Relay Assembly Test Room, showed that changes in intensity of illumination, heat, humidity, hours of work, etc., affected workers far less than had been believed. The human organism seems to be able to maintain a state such that it makes unconscious and automatic compensation for these changes. In fact, once other factors have been adequately taken into account, there is no single factor in work which can be identified as fatigue, except

the general feeling at the end of the day that one is ready to go to bed.

6. On the other hand, the efficiency of workers is often affected by what can only be called the "psychological" or "social" conditions of work. The further statements attempt to specify what these conditions are.

7. Workers in industry have many strong sentiments in regard to such things as age, sex, nationality, occupation, social responsibility, workmanship, work history, and the like. The workers have seldom formulated these sentiments clearly in their minds, but the sentiments can be inferred from what they do and say. In fact, many of the statements workers make cannot be taken as objectively correct or incorrect but only as symptomatic of these emotional assumptions or attitudes. Action which is a manifestation of these sentiments is a man's chief method of adjusting himself to the behavior of others.

8. The sentiments are not to be regarded as individual products but as the precipitate of the interaction of men in groups. Certain sentiments are common to all the members of the group. Persons who hold similar positions within the group tend to hold similar sentiments.

9. The last statement raises the question of social groups in industry. Under all conditions of work social groups are being formed, in the course of collaboration, as a result of mere physical proximity, or for other reasons. The members of such groups have more interactions with one another than with persons whom they consider outsiders. They develop leaders. They develop common purposes. They develop the sentiments spoken of above. They develop customs: group codes of behavior. In brief, the characteristic of such groups is the routine interaction of their members. Intangible satisfactions come to a worker from being a member of a closely knit group.

10. The complex of such groups in an industrial plant is spoken of as the social organization of the plant. To some extent this organization is formally recognized, especially as it is determined by the stated purposes of the plant. A department, for instance, is a social group so recognized. This part of the organization is called the formal organization. There is another part which is not formally recognized, and this part is called the informal organization. The informal organization, like social organization in general, is not capable of rapid change. Perhaps the single most important result of the Western Electric researches was the discovery and demonstration of the significance of informal organization. Of course,

many of these things were intuitively known before, but it makes all the difference to bring out into the open what has been known only intuitively. Methodical research is the process by which the intuitive is made explicit.

11. Mr. Barnard has pointed out that informal organization must always exist in conjunction with formal organization and that it has at least two important functions: to transmit information and understandings which, for one reason or another, cannot be transmitted by the formal communication system, and to allow means for individuals to escape from certain effects of formal organizations which tend to disintegrate the personality.

12. Conditions which do not allow a worker to act easily in accordance with his existing sentiments, that is, which do not allow him to relate himself effectively to other persons as a member of a group, or which interfere with his conformity to the code of his group, constitute for him an experience of personal futility. Such conditions may lead a person who is otherwise normal to a form of pathological response, to heavy preoccupation, pessimistic revery, and further inability to adjust to the social environment. Such conditions occur in industry.

13. In organizing the work in an industrial plant, the persons in authority tend to act upon certain assumptions of their own, which have been a part of the intellectual tradition of western civilization for at least the last century. They are inclined to assume that the worker is motivated primarily by his material interests, that he acts rationally in pursuit of these interests, and that society consists of a mass of individuals related to one another only through the action of formal authority. The fact that this picture is distorted might have been recognized if the further tradition of factory organization had not asserted, in effect, that of the factors determining human behavior, only logic and economic interest need be given explicit attention. Common sense and informal behavior will take care of the others. This tradition may well have been a useful one in the conditions in which it grew up, in small factory units; but it is probably not useful in the huge industrial organizations of the present day.

14. Furthermore, the management of an industrial plant is necessarily preoccupied with progressive change. It is continually studying its methods so as to make them more efficient. So preoccupied, and making the assumptions it does, management gives a series of orders which are transmitted through a hierarchy of supervisors to the employees who are doing the physical work. At that level, the action taken often does violence to the workers' sentiments and is

felt to be a threat to their informal social organization. The result is the appearance in some individual workers of the pessimistic revery above described and the assumption by the informal group of a protective function. Without planning, without conscious thought, the informal social organization acts as if it intended to prevent management from having any excuse for interfering with the workers. Restriction of output is one sign of such protective action. In short, the technical organization is geared to rapid change. The social organization, on the other hand, cannot change rapidly and acts so as to protect itself against change.

15. Having assumed these protective functions, the informal organizations of employees somewhat resemble formally organized labor unions. In fact, Mr. Ruttenberg pointed out that in organizing a factory a union, if it works skillfully, makes every effort to win over the leaders of the existing informal groups. When they have joined the union, their followers will naturally join. The formation of unions, industrial unrest, and strikes have usually been interpreted as efforts on the part of the workers to gain such things as higher wages, shorter hours, and better physical conditions of work. And there is no doubt that they often are efforts of this sort. But the evidence strongly suggests that even a plant which sets a high standard in wages, hours, and physical conditions of work will still not be free from industrial unrest, strikes, and lockouts, if the action taken by management creates unsatisfactory social conditions of work in the sense described above. In particular the evidence suggests that it is important that workers shall have some participation in setting output standards and that they shall have opportunities for "self-expression." It suggests that the management which is most enlightened in establishing good working conditions will not secure the results it desires if it acts by executive order without the participation of the workers.

16. The problem can be seen as one of communication in the industrial hierarchy. Consider, in the first place, communication downward. Management has not succeeded in instilling confidence in the workers as to its intentions in instituting the rapid changes necessary in modern industry. The same management which will make an effective effort to sell its products to its customers may make none at all to sell its actions to its employees. This statement does not mean that the job of management is to explain the logic of what it does to the man at the bottom. It does mean that the job of management is to show the man at the bottom that what he considers important is in fact being treated as such at the top. It is a job of reassurance. Consider, in the second place, communication

upward. The picture of the work situation at the lower levels—the sentiments of the workers, their informal social organization—is not transmitted to management. The reasons for this failure are at least two: these matters have not been considered important, and they are inherently difficult to communicate. The higher a man moves in the hierarchy of management, the less he can rely on any intuitive understanding of the welter of factors which make up the work situation, the more he is forced to rely on logic, on explicit generalization. Therefore it is of the first importance that his generalizations shall be adequate. The generalizations on which management has so far been acting are inadequate, being weighted too heavily by the logic of efficiency and economics. One of the functions of personnel counseling at the Hawthorne Works is to provide more adequate generalizations. In short, there tends to be a failure of communication in both directions through the industrial hierarchy, failure in one direction being at once the cause and the consequence of failure in the other. The failure shows itself in lowered satisfaction for individuals and impaired authority in the organization. On the other hand, where for any reason communication both upward and downward is good, satisfaction is high and authority is strong. In the Western Electric researches, the great instance is the Relay Assembly Test Room.